MODERN DENTAL MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS

BUCKLEY

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MODERN DENTAL MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS

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Modern Dental Materia Medica, Pharmacology and Therapeutics

INCLUDING THE PRACTICAL APPLICATION OF DRUGS AND REMEDIES IN THE TREATMENT OF DISEASE

BY

J. P. BUCKLEY, Ph. G., D. D. S.

PROFESSOR AND HEAD OF THE DEPARTMENT OF MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS, AND FORMERLY DIRECTOR OF THE CHEMICAL LABORATORIES, CHICAGO COLLEGE OF DENTAL SURGERY.

THIRD EDITION, REVISED

SEVENTY-TWO ILLUSTRATIONS

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Printed in America.

TO

THE MEMORY OF

MY MOTHER,

WHOSE ENCOURAGEMENT IN MY BOYHOOD DAYS

SERVED ME SO WELL,

AND TO

MY WIFE,

FOR MANY WILLING SACRIFICES DURING THE

PAST ELEVEN YEARS,

THIS VOLUME IS FONDLY

DEDICATED.

PREFACE TO THE THIRD EDITION.

The printing of the third edition in twenty months after the first appearance of this book has enabled the author to again make such alterations and corrections as would enhance the value of the work. The text has been changed slightly throughout and several new and original illustrations have been added. The greatest change has been made in the treatment of chronic alveolar abscess. Dentists in the past have placed too much dependence in drugs as the means of correcting root and bone complications; and, as a result, many teeth, thus diseased, have been needlessly extracted. Therefore the surgical treatment of these complicated conditions has been considered more fully and new illustrations added to aid in both the diagnosis and treatment. It has been my desire to improve the book without enlarging it, and to make the text still more clear, direct and practical.

J. P. BUCKLEY.

CHICAGO.

PREFACE TO THE FIRST EDITION

The general plan of this book is the outgrowth of many years of experience as a dental practitioner and teacher of Materia Medica, Pharmacology and Therapeutics in dental colleges. During these years, the author has realized the need of a text-book which would meet the wants of teacher, student and practitioner.

The book is intended to include all that a dentist should know about drugs and remedies and their practical application in the treatment of disease.

The work is divided into two parts. The first is devoted to Materia Medica and Pharmacology, with enough Therapeutics to indicate clearly the uses of the various drugs and remedies; and an effort has been made to include herein every drug or remedy which is employed in Dental Therapeutics, except, those which are obsolete, untried or savor of the "secret formula" variety. To accomplish this end, it was, of course, necessary to consult freely the United States Pharmacopeia, and other standard works on these subjects.

Drugs marked with an asterisk (*) means that the drug is a member of the group under consideration, but because of other properties which the agent possesses, it has been elsewhere considered. In most instances, the drug is discussed under the group in which it is first mentioned, and if it is referred to subsequently in another group, it is there marked with an asterisk. For example, phenol is mentioned first as a disinfectant under which group of drugs it is discussed. Later it is mentioned in the group of escharotics, and is there marked with an asterisk.

In this part of the book, also, is included Prescription Writing and its associated subjects—Metrology, Medical Latin and Incompatibility, all of which have been given the dignity and importance they deserve in a dental course. It will be observed that no prescriptions have been written until after Prescription Writing has been discussed; after which, however, no formula has been mentioned without a correctly written prescription for the same. This plan was followed for the benefit of teachers and students in dental colleges. Prescriptions, as a rule, are confusing, though enticing to beginners, and questions naturally suggest themselves in regard to the various signs and terms used. For the teacher to attempt to explain these before the subject proper had been studied would be a loss of time, as no one can

write a prescription intelligently without first being familiar with drugs. Therefore, it is better, in the author's opinion, to avoid even the suggestion of questions pertaining to prescriptions at this time. By thus deferring the study of Prescription Writing to about the close of the Junior year, an excellent opportunity is afforded for practice work throughout the entire Senior year when Practical Therapeutics is taught. By this means only can students become good prescription writers—a faculty not developed by the average dentist.

The second part of the book is devoted to Practical Dental Therapeutics. In writing it the author was actuated by the belief that Dental Therapeutics is of sufficient importance to occupy a place in dentistry by itself. It is to be hoped that this subject may ultimately be divorced from Operative Dentistry, to which it has long been subordinated.

No attempt has been made to describe all of the many methods of treatment, nor to give the endless formulas suggested in the various text-books and journals, for the pathologic conditions mentioned herein. To do so would lead to confusion, as well as make the book unnecessarily voluminous, in which case the word "practical" in connection with "therapeutics," as used here, would be a misnomer. Therefore, in most instances, only the methods by which the conditions are treated in the author's own practice are detailed. These methods, of course, are not wholly original. They have been gleaned from clinical experience, from extensive reading, and from observation and association with other practitioners; and in both private and infirmary practice they have given good results.

The prescriptions for remedies, for the most part, are original with the author, and have been worked out along the lines of practical pharmacy and therapeutics. Where the formulas are not original, due credit, so far as is known, has been given.

It is unnecessary to profusely illustrate a book of this kind. Only such illustrations as will tend to better explain the subject matter of the text are given. These, with few exceptions, were taken from actual cases in the author's practice, or from private patients referred to him for treatment.

The author desires to express his grateful appreciation to Dr. E. W. Elliot for valuable suggestions, to Dr. Lee K. Stewart for furnishing models to illustrate a practical retaining appliance, and to other professional friends for the encouragement given in undertaking the work. He further records his appreciation of the publisher's unfailing courtesy.

J. P. BUCKLEY.

CHICAGO.

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PART I.

MODERN DENTAL MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS.

Materia medica is the science that treats of drugs, the study of which includes the source, constituents, physical and chemic properties of the inorganic and organic materials used for drugs.

Pharmacology is the science that treats of the *action* of drugs upon the tissues, organs and functions of the body. It is, therefore, the study of the changes induced in living organisms by the administration of such substances as do not act as foods. Formerly this science was called *Pharmacodynamics*. That part of Pharmacology devoted to the study of Poisons is called *Toxicology*.

Therapeutics is the science that deals with the *application* of drugs or remedies to the treatment of disease.

The treatment of disease based solely on clinical experience, whereby remedies are administered or applied without reference to their physiologic action, is known as *empirical therapeutics*. The application of the essential oils to the canals of teeth containing putrescent pulps, or the giving of salicylic acid, sodium salicylate or the lithium salts in cases of pyorrhea alveolaris, supposed to be associated with rheumatism or gout, are examples of empirical therapeutics.

The treatment of disease by the employment of drugs which, from a knowledge of their physiologic actions, are expected to counteract certain known pathologic conditions, is recognized as *rational therapeutics*. The application of remedies containing formaldehyd to a putrescent root-canal, wherein it is expected that the formaldehyd gas will neutralize the gaseous end-products of pulp decomposition, may be given as an illustration of rational therapeutics.

While it is essential that the student should understand at the very outset the definition of the terms *materia medica*, *pharmacology* and *therapeutics*, it is also essential that other general terms used throughout the text should be thoroughly mastered at this time.

A medicine is any substance used in the treatment of disease.

A drug is any substance which may be used as a medicine, or it may be used purely in chemic processes and not directly in the treatment of disease.

A remedy is a broader term and includes, besides material substances such agents or means employed in therapeutics as heat, cold, light, electricity, massage and suggestion. Remedies, therefore, may be divided as follows:

> *Prophylactic Remedies.*—Those used to prevent disease, as polishing tooth-surfaces to prevent caries, or vaccination to prevent smallpox.
>
> *Hygienic Remedies.*—Those that assist in the maintenance of health, such as pure air, water, food and bathing.
>
> *Imponderable remedies.*—These include heat, cold, light, electricity, massage and suggestion.
>
> *Mechanical remedies.*—These involve the use of bandages, splints, instruments, etc.
>
> *Pharmacologic remedies.*—These are called also *medicinal remedies* and are the material substances or medicines used in the treatment of disease.

There are several closely related terms employed in the study of the practical uses of remedies, which often lead to confusion. It is well that the student understand these terms at the very outset. The term **specific** has a double meaning. When used in connection with a remedy it means that the remedy, if used in the proper manner, can generally be depended upon to produce definite results in certain diseases. For example, formocresol is a specific for putrescent pulp conditions; antitoxin is a specific for diphtheria. There are but few specific remedies. Applied to a disease, the term specific means syphilis, and it is so used by physicians and dentists to indicate that disease which has associated with it the stigma of vice. Therefore, syphilis is generally spoken of as a **specific disease.**

The terms **physiologic action, physiologic effect** and **therapeutic effect** are too frequently used interchangeably, without reference to their true meaning. There is a distinction between the action and the effect of a drug. Many times the action of a drug is obscure, but the effect, if produced, must necessarily be apparent. This is nicely illustrated by the inhalation of ammonia in cases of syncope (fainting). The *action* of the ammonia gas is that of an irritant on the respiratory mucous membrane, while the *physiologic effect* desired in this instance is cardiac and respiratory stimulation. This is brought about reflexly by the local irritation; for ammonia, thus administered, produces a marked increase in both the strength and rapidity of the pulse and the depth and rapidity of the respirations.

In the case mentioned above, the *therapeutic effect* would be the return of consciousness, which might not follow without further treatment. It is therefore possible to have the physiologic action and effect of a drug without the therapeutic effect.

Resolution is a term which indicates the return of an abnormal to a normal condition, and means structural recovery. **Dissolution** is a term which means death.

The author desires here to emphasize the importance of learning the distinction between these several terms, for they are too often used synonymously, without reference to their true meaning.

A poison is any substance which, when administered or applied, by its inherent physical or chemic properties causes disease or death. That branch of medical science which treats of the action and effects of poisons, their detection, and the treatment of the conditions resulting therefrom, is called *toxicology*.

Pharmacy is the art of preparing, compounding and dispensing medicines.

The Pharmacopeia is an authoritative work which: 1. establishes *standards* and *tests* for the identification, quality, purity and strength, and 2. gives *directions* for the preparation, purification and preservation of drugs and medicines. How to prepare, purify and preserve medicines is the work of the pharmacist, but every practising dentist should be familiar with certain standards and tests for the identity, quality, purity and strength of the medicines employed in daily practice.

The pharmacopeias may be considered the medico-legal authorities for drugs and medicines in their respective countries.

The United States Pharmacopeia (abbreviation, U. S. P.) is prepared by a committee consisting of delegates appointed by authority from regularly incorporated medical and pharmaceutic societies and colleges. This pharmacopeial committee meets at the beginning of each decade, and the code of remedial agents thus established is intended to serve as a standard until superseded by a new revision. The last (eighth) edition of the U. S. P. became the official standard September 1, 1905.

A dispensatory is a commentary on the pharmacopeia, including, as do the American Dispensatories, all information pertaining to the pharmacy as well as the action and uses of medicines. Dispensatories are private publications, and should be used only as references, for they are not intended to take the place of the standard and legal authority—the Pharmacopeia.

By admitting certain articles to the pages of the U. S. P., it declares them to be of sufficient importance as to merit confidence in their use in the practice of medicine. Articles thus recognized are said to be "official." This should not be taken to mean that articles not admitted are valueless, for there are many formulas in common use to-day which are exceedingly valuable, though not official. The American Pharmaceutic Association, recognizing this fact, has prepared an important collection of formulas, which is, therefore, in a sense authoritative, called the *National Formulary* (abbreviation, N. F.), and which will be referred to, whenever occasion requires, throughout this work; however, the official preparations, or a combination of two or more, will largely furnish the basis for the formulas given by the author in that part of the book devoted to practical therapeutics.

SOURCES OF DRUGS AND CONSTITUENTS OF THOSE OF VEGETABLE ORIGIN.

Drugs are derived from the three kingdoms of nature—*mineral*, *animal* and *vegetable*. Those which belong to the mineral kingdom are called *inorganic drugs*, and are obtained by chemic processes directly from nature. *Organic drugs* are those which are taken from the animal and vegetable kingdoms. The element, *carbon*, plays the leading rôle in all organic drugs, and is combined in the compounds of carbon with such elements as *hydrogen*, *oxygen*, *nitrogen*, and others.

The constituents of vegetable drugs of value in medicine and dentistry are called *the active principles*, and they include carbohydrates, alkaloids, glucosids, neutral principles, organic acids, volatile oils, resins, gums, fixed oils and fats, camphors and other miscellaneous compounds.

Carbohydrates are largely used as foods, yet many of them, owing to their bland and soothing action, are employed as medicines. These include *starch* and the *sugars*.

Alkaloids are nitrogenous compounds, having the reaction and basic properties of alkalies. They are odorless, have a bitter taste, and generally possess powerful physiologic actions. Alkaloids are almost insoluble in water, but they readily combine with acids to form crystallizable salts which are freely soluble. For example, *cocain* is an alkaloid, and, as such, is not largely used in dental practice; but, when acted upon by hydrochloric acid, cocain hydrochlorid is formed, and this alkaloidal salt is one of our most useful drugs.

Other examples of alkaloids are, *strychnin*, *morphin*, *atropin*, etc. The term *artificial alkaloid* is used to designate secondary alkaloids derived from natural ones, as *apomorphin*, which is obtained by abstracting from morphin a molecule of water.

Glucosids comprise those vegetable principles which may be resolved by boiling with dilute acid or alkalies, or by the action of ferments, into glucose and one or more other products peculiar to the substance tested. *Glycyrrhizin*, obtained from liquorice-root, and *salicin*, from willow-bark, are examples.

Neutral principles are neutral constituents, differing from alkaloids in not being basic in character and from glucosid in not being resolvable into glucose. *Aloin*, from aloes, and *piperin*, from black pepper, are examples.

Organic acids are found in many plants, either free or combined with alkaloids or inorganic bases. Those of most value in dentistry are *acetic*, *benzoic*, *lactic*, *salicylic*, *oxalic*, and *tannic* acids.

Volatile oils, also called *essential oils*, form a large group of organic bodies, from which they are chiefly obtained by distillation. They are highly odorous, oily, sparingly soluble in water, more or less soluble in alcohol and ether, and prone to become resinous on exposure to air. In the past the volatile oils have occupied a prominent place in dental practice. Those to be remembered are the oils of *cinnamon*, *cloves*, *peppermint*, *wintergreen*, *turpentine*, *eucalyptus*, and *cajuput*.

Resins are exudations associated with, and probably derived from, volatile oils. They are insoluble in water, but freely soluble in alcohol. Examples of resins are those of *jalap*, *podophyllum* and *common rosin*.

Gums are dried exudations obtained by incising the limbs and branches of certain plants. Gums, contrary to resins, are insoluble in alcohol, but freely soluble in water. The most important gums are those of *acacia* and *tragacanth*. Ordinary mucilage is a solution of certain gums in water.

Fixed oils and fats are obtained by simple pressure, and are not readily volatilized. Those used chiefly in dentistry are *lard*, *lard oil*, *olive oil*, *castor oil*, and *oil of theobroma* (cacao butter).

Camphors are solid and crystallizable bodies, closely associated in plants with *terpenes*, *i.e.*, compounds of carbon and hydrogen in the proportion $C_{10}H_{16}$, and probably derived from them by oxidation. The principal member of the group is official camphor, $C_{10}H_{16}O$. *Stearoptenes*, obtained from various essential oils, as *menthol* and *eu-*

calyptol, are sometimes called camphors, but should not be so considered.

Miscellaneous compounds are such proximate principles as are not referable to the groups mentioned. They include several compounds of value to dentistry, as *eucalyptol*, *eugenol*, *thymol* and *guaiacol*.

PARTS OF PLANTS USED FOR DRUGS.

The crude organic drugs which form a large part of the materia medica are chiefly derived from the vegetable kingdom. All the different parts of plants are used. The active principle is often distributed throughout the entire plant, but is generally found more abundantly in one particular part, which is then used. For convenience in study, the *parts of plants used for drugs* can be divided into portions which grow *under* and *above* the ground.

Portions Under Ground.—The *root* (*radix*) proper is that part of the plant-axis which does not bear leaves. Roots are ordinarily subterranean (grow underground) in their habits, and serve the double use of attaching the plant securely to the soil and of enabling it to absorb from the latter the necessary food. The roots of some plants not only perform these functions, but become greatly thickened and serve also for the accumulation of reserve food material and are then called *tubers* (potato, beet and turnips). Roots possess a bark which is sometimes used separately (sassafras). If the underground portion of a root does bear leaves, it is termed *rhizome* (*rhizoma*). This is sometimes called a subterranean stem. When the root-leaves become enlarged and serve as storehouses for food, a *bulb* (*bulbus*) is formed. The onion is an example. The lowest part of the stem of a plant is often thickened, and is then called *corm* (*cormus*).

Portions Above Ground.—When the entire plant, except the root, is employed, it is called *herb* (*herba*). This consists of stems, leaves, and often flowers or fruit.

The *stem* proper is that part of the plant-axis which bears leaves or some modification of them. Its functions are, to form such a support for the leaves as will duly expose them to the influence of light and air, to bear the floral organs and convey to them the necessary nutriment, and to form a means of communication and interchange between the roots, or organs which absorb the crude nutritive material from the soil, and the leaves, or organs which assimilate this food. With small, herby plants the stem is called *stipes;* with larger plants it is

transformed into *wood* (*lignum*) and is covered with *bark* (*cortex*). The outer layers of the older bark are always corky, and a secondary bark develops inside of this which is called *liber*.

The *leaves* (*folia*) are stem-appendages, regularly arranged upon the stem, and consist of expansions of its tissues. *Buds* may be considered as rudimentary stems, with rudimentary leaves compactly arranged upon them.

The *flower* (*flos*) is a special modification of the leaves. It consists of the *calyx* (usually green parts called *sepals*) and a *corolla*. The latter is made up of showy leaflets (petals) and the inconspicuous, but important, male and female elements called *stamens* and *pistil*, respectively. The stamens bear the fertilizing element in the form of granules, termed *pollen*. The pistil consists of the *ovary*, which develops the *seed* (*semen*), and the *style* and *stigma*, which serve to receive the pollen. After fertilization takes place, the ovary develops into the *fruit* (*fructus*); this may also involve neighboring parts, especially the top of the stem, as in the apple and strawberry. The fruit consists of the outer portion, *pericarp*, and the seeds. The latter contains the embryo and nutriment material, and is protected by a more or less hard shell. Certain organic drugs consist of the coagulated *juices* of the plants and show no structure (opium, etc.).

PHARMACEUTIC PREPARATIONS.

Pharmaceutic preparations are those preparations made by the pharmacists, the formula being given for their preparation in the United States Pharmacopeia; and nearly one-half of the articles of the U. S. P. are *pharmaceutic*.

The pharmaceutic preparations may be classified as follows:

I. The solutions.
II. The mixtures.
III. Products by extraction.
IV. Mixtures of solids.
V. Preparations for external use.

These groups are subdivided into a number of classes, each class having a distinct Latin title which officially designates its members, or individual preparations, and by which they are alphabetically arranged in the U. S. P. Besides the Latin and English titles, each class is also known by an English name and various synonyms. The student will gradually become acquainted with the various classes and names of each by carefully studying the following classification:

I. THE SOLUTIONS.

The general class of pharmaceutic preparations called "The Solutions" includes nine subclasses, each classified according to the solvent used.

1. **Medicated Waters.—Aquæ Medicatæ.** Medicated waters are solutions of *volatile* substances in water. They embrace the popular aqueous solutions of the volatile oils, and in these cases are made by first triturating the oil with some insoluble substance, as talc, precipitated calcium phosphate, or magnesium carbonate, thus dividing the globules of the oil and distributing it over much surface, after which water is added, when, by filtering, the water abstracts from the mixture all of the oil that it is capable of holding in solution. These medicated waters are so popular in dental practice that the following formula from the U. S. P., as typical of this class, is here given:

Cinnamon Water.

Oil of Cinnamon, *two cubic centimeters* (2 c.c.—30 m.).
Talc, *four grammes* (4 gm.—1 dr.).
Distilled Water, a sufficient quantity.
To make *one thousand cubic centimeters* (1,000 c.c.—1 qt.).
Triturate the Oil of Cinnamon with the Talc, add the distilled Water, gradually, under constant trituration, and filter.—U. S. P.

The waters most commonly used are:

Ammonia Water (Aqua Ammoniæ).
Camphor Water (Aqua Comphoræ).
Cinnamon Water (Aqua Cinnamomi).
Hamamelis (witch-hazel) Water (Aqua Hamamelidis).
Hydrogen Dioxid Water (Aqua Hydrogenii Dioxidi).
Peppermint Water (Aqua Menthæ Piperitæ).
Rose Water (Aqua Rosæ).

2. **Solutions.—Liquores.** These preparations are solutions of *non-volatile* substances in water. The official solutions contain only inorganic salts.

The most important solutions are:

Antiseptic Solution, Mouth-wash (Liquor Antiseptici).
Solution of Calcium Hydroxid, Lime-water (Liquor Calcis).
Compound Solution of Cresol (Liquor Cresolis Compositus).
Compound Solution of Chlorin (Liquor Chlori Compositus).
Solution of Ferric Subsulphate, Monsel's Solution (Liquor Ferri Subsulphatis).
Solution of Formaldehyd, Formalin (Liquor Formaldehydi).

Compound Solution of Iodin, Lugol's Solution (Liquor Iodi Compositus).
Solution of Magnesium Citrate (Liquor Magnesii Citratis).
Solution of Potassium Hydroxid (Liquor Potassii Hydroxidi).
Solution of Sodium Hydroxid (Liquor Sodii Hydroxidi).
Solution of Chlorinated Soda, Labarraque's Solution (Liquor Sodæ Chlorinatæ, N. F.).

3. **Spirits.—Spiritus.** The spirits are solutions of *volatile* substances in Alcohol. Of the twenty official, two are "natural" spirits (made by distillation, *Whisky* and *Brandy*), fifteen are solutions of essential oils, and are called "Aromatic Spirits" or "Essences."

The most important spirits are:

Spirit of Ammonia (Spiritus Ammoniæ).
Aromatic Spirit of Ammonia (Spiritus Ammoniæ Aromaticus).
Brandy (Spiritus Vini Gallici).
Spirit of Camphor (Spiritus Camphoræ).
Spirit of Cinnamon (Spiritus Cinnamomi).
Compound Spirits of Ether, Hoffmann's Anodyne (Spiritus Ætheris Compositus).
Compound Spirit of Juniper (Spiritus Juniperi Compositus).
Spirit of Myrcia, Bay-rum (Spiritus Myrciæ) (Unofficial).
Spirit of Nitroglycerin, Spirit of Glonoin (Spiritus Glycerylis Nitratis).
Spirit of Peppermint (Spiritus Menthæ Piperitæ).
Whisky (Spiritus Frumenti).

4. **Syrups.—Syrupi.** Syrups are nearly *saturated* solutions of *sugar* in *water*, in which medicinal or flavoring agents are dissolved. The most important syrups are:

Simple Syrup (Syrupus) (85 per cent. Sugar).
Syrup of Acacia (Syrupus Acaciæ).
Syrup of Calcium Lactophosphate (Syrupus Calcii Lactophosphatis).
Syrup of Wild Cherry (Syrupus Pruni Virginianæ).
Syrup of Ginger (Syrupus Zingiberis).
Compound Syrup of Hypophosphites (Syrupus Hypophosphitum Compositus).
Syrup of Ipecac (Syrupus Ipecacuanhæ).
Syrup of Iron, Quinin and Strychnin Phosphates (Syrupus Ferri, Quininæ et Strychninæ Phosphatum).
Compound Syrup of Sarsaparilla (Syrupus Sarsaparillæ Compositus).
Compound Syrup of Squill, Coxe's Hive Syrup (Syrupus Scillæ Compositus).
Syrup of Tolu (Syrupus Tolutanus).

5. **Honeys.—Mellita.** Honeys are solutions of certain substances in clarified honey. Honey of rose (mel rosæ) is an example.

6. **Elixirs.—Elixiria.** Elixirs are solutions containing aromatic substances, sugar, alcohol, and water. They are used largely to mask the taste of nauseating drugs. The official elixirs are:

Adjuvant Elixir (Elixir Adjuvans).
Aromatic Elixir (Elixir Aromaticum).
Elixir of Iron, Quinin and Strychnin Phosphates (Elixir Ferri, Quininæ et Strychninæ Phosphatum).

7. **Glycerites.—Glycerita.** Glycerites are solutions of *medicinal substances* in glycerin. The most important glycerites are:

Glycerite of Boroglycerin (Glyceritum Boroglycerini).
Glycerite of Iron, Quinin and Strychnin Phosphates (Glyceritum Ferri, Quininæ et Strychninæ Phosphatum).
Glycerite of Phenol, Glycerite of Carbolic Acid (Glyceritum Phenolis).
Glycerite of Starch (Glyceritum Amyli).
Glycerite of Tannic Acid (Glyceritum Acidi Tannici).

8. **Oleates.—Oleata.** Oleates are solutions of *metallic oxids* or *alkaloids* in oleic acid. The useful oleates are:

Oleate of Cocain (Oleatum Cocainæ).
Oleate of Mercury (Oleatum Hydrargyri).
Oleate of Quinin (Oleatum Quininæ).

9. **Collodions.—Collodia.** Collodions are solutions of *medicinal substances* in collodion; *i.e.*, gun-cotton (pyroxylin) dissolved in ether and alcohol. These preparations are used externally, and chiefly as protectants. The important collodions are:

Collodion (Collodium).
Cantharidal Collodion, Blistering Collodion (Collodium Cantharidatum).
Flexile Collodion (Collodium Flexile).
Styptic Collodion (20 per cent. Tannic Acid) (Collodium Stypticum).

II. THE MIXTURES.

This general class of pharmaceutic preparations includes such liquid preparations as are not clear solutions, or solutions that cannot be classified according to the solvent used. There are three subclasses:

1. **Mixtures.—Mistura.** Mixtures are liquid preparations usually holding in suspension in water some insoluble substance. Mixtures should be well shaken before being administered. Examples of official mixtures are:

Mixture of Chalk (Mistura Cretæ).
Mixture of Rhubarb and Soda (Mistura Rhei et Sodæ).

2. **Emulsions.—Emulsa.** Emulsions are liquid preparations consisting of oily, fatty, resinous, or otherwise *insoluble* substances, suspended in water by the aid of some gum or mucilage called the *emulsifying agent*, as acacia or tragacanth. Milk and the yelk of egg are natural emulsions. The important official emulsions are:

Emulsion of Cod-liver Oil (Emulsum Olei Morrhuæ).
Emulsion of Oil of Turpentine (Emulsum Olei Terebinthinæ).

3. **Liniments.—Linimenta.** These are liquid preparations for external use, consisting of solutions of *oily* or *resinous* constituents in alcohol or oils, or mixtures of liquid soaps. With the exception of belladonna liniment and lime liniment, which are used as sedative applications, all the official liniments are of a stimulating character, and should be applied with friction or massage. The useful official liniments are:

Belladonna Liniment (Linimentum Belladonnæ).
Lime Liniment, Carron Oil (Linimentum Calcis).
Camphor Liniment (Linimentum Camphoræ).
Liniment of Soft Soap, Tincture of Green Soap (Linimentum Saponis Mollis).

III. PRODUCTS BY EXTRACTION.

The medicinal constituents, called *active principles*, of crude drugs are obtained by extraction. The liquid used is termed the *menstruum*, and may be water or alcohol or both in varying proportions, with sometimes the addition of glycerin. This general class is represented by ten subclasses.

1. **Mucilages.—Mucilagines.** These are solutions of gums or other mucilaginous constituents of vegetable drugs extracted with an aqueous menstruum. They are used as emollients, as emulsifying agents for suspending insoluble substances in liquids, and as excipients for pills.

The official mucilages are:

Mucilage of Acacia (Mucilago Acaciæ).
Mucilage of Sassafras Pith (Mucilago Sassafras Medullæ).
Mucilage of Tragacanth (Mucilago Tragacanthæ).
Mucilage of Elm (Mucilago Ulmi).

2. **Infusions.—Infusa.** Infusions are liquid preparations made by pouring boiling water on vegetable drugs in a suitable vessel provided with a cover, allowing it to stand for a certain period, and then straining. Tea, if properly made, is an infusion. An example of an official infusion is:

Compound Infusion of Senna, Black Draught (Infusum Sennæ Compositum).

3. **Decoctions.—Decocta.** Decoctions are liquid preparations made by pouring boiling water on vegetable drugs in a suitable vessel provided with a cover, allowing it to boil for a certain length of time, and then, when sufficiently cooled, strain. Coffee, as usually made, is a decoction. There are no official decoctions.

4. **Vinegars.—Aceta.** Vinegars are liquid preparations made by treating vegetable drugs with dilute acetic acid. They are not much used in dentistry. Only two are official:

Vinegar of Opium (Acetum Opii).
Vinegar of Squills (Acetum Scillæ).

5. **Wines.—Vina.** These are alcoholic liquids made by fermenting fresh grapes. *Medicated wines* are made by extracting the soluble constituents of vegetable drugs with white wine as the menstruum, to which 10 to 15 per cent. of alcohol is added, which aids in extracting and in preserving the preparation. The official wines of value are:

Wine of Coca (Vinum Cocæ).
Wine of Ergot (Vinum Ergotæ).
Wine of Ipecac (Vinum Ipecacuanhæ).
Wine of Opium (Vinum Opii).
Red Wine (Vinum Rubrum).
White Wine (Vinum Album).

6. **Tinctures.—Tinctura.** These are alcoholic or hydroalcoholic solutions of the soluble constituents of crude drugs or of non-volatile substances (except iodin). Tinctures are the simplest form of alcoholic products by extraction, and as a class have no uniform strength. From a tincture all the other preparations may be *progressively* produced through concentration by evaporating the menstruum, as follows:

Fluid extract representing a uniform drug-strength, viz.: 1 troy ounce in 1 fluidounce (1 gram in 1 c.c.).

Extract, or "solid extract," a semi-solid mass of pilular consistence of no uniform drug-strength, or assayed and powdered with diluent, to represent a certain alkaloidal strength (opium and nux vomica).

Abstract, or "powdered extract," by incorporating sugar of milk with the extract to reoresent one-half the weight, or twice the strength of the drug.

Resins, separation of the resinous constituents, by precipitation in water of a concentrated alcoholic tincture. Three of the most important tinctures are required by the U. S. P. to be assayed as they must possess a certain specified alkaloidal strength. They are *tincture of opium, tincture of deodorized opium, and tincture of nux vomica.*

Tinctures are applied locally or administered internally by dentists more than any other subclass of pharmaceutic preparations. The following tinctures are among the most important:

Tincture of Aconite (Tinctura Aconiti).
Tincture of Belladonna Leaves (Tinctura Belladonnæ Foliorum).
Tinctura Benzoin (Tinctura Benzoini).
Compound Tincture of Benzoin (Tinctura Benzoini Composita).
Tincture of Indian Cannabis (Tinctura Cannabis Indicæ).
Tincture of Cantharides (Tinctura Cantharidis).
Tincture of Capsicum (Tinctura Capsici).
Tincture of Calendula (Tinctura Calendulæ).
Tincture of Cinchona (Tinctura Cinchonæ).
Compound Tincture of Cinchona, Huxham's Tincture (Tinctura Cinchonæ Composita).
Tincture of Digitalis (Tinctura Digitalis).
Tincture of Gelsemium (Tinctura Gelsemii).
Compound Tincture of Gentian (Tinctura Gentianæ Composita).
Tincture of Hyoscyamus (Tinctura Hyoscyami).
Tincture of Iodin (Tinctura Iodi).
Tincture of Krameria (Tinctura Krameriæ).
Tincture of Nux Vomica (Tinctura Nucis Vomicæ).
Tincture of Opium, Laudanum (Tinctura Opii).
Camphorated Tincture of Opium, Paregoric (Tinctura Opii Camphorata).
Tincture of Rhubarb (Tinctura Rhei).
Ammoniated Tincture of Valerian (Tinctura Valerianæ Ammoniata).

7. **Fluid extracts.—Fluidextracta.** These are concentrated tinctures of such strength as to represent the drug *volume for weight*, *i.e.*, one fluidounce must represent the active principles of one troy ounce of the crude drug (1 c.c. = 1 gram).

The preparations in this class are prescribed largely by physicians, for they possess the advantage of having a uniform strength. They are not employed by dentists, however, as much as are the tinctures. The most important fluid extracts are:

Fluid Extract of Indian Cannabis (Fluidextractum Cannabis Indicæ).
Aromatic Fluid Extract of Cascara Sagrada (Fluidextractum Rhamni Purshianæ Aromaticum).

Fluid Extract of Cinchona (Fluidextractum Cinchonæ).
Fluid Extract of Coca (Fluidextractum Cocæ).
Fluid Extract of Ergot (Fluidextractum Ergotæ).
Fluid Extract of Gelsemium (Fluidextractum Gelsemii).
Fluid Extract of Hydrastis (Fluidextractum Hydrastis).
Fluid Extract of Hyoscyamus (Fluidextractum Hyoscyami).
Fluid Extract of Nux Vomica (Fluidextractum Nucis Vomicæ).
Fluid Extract of Senna (Fluidextractum Sennæ).

8. **Extracts.—Extracta.** These are *soluble active principles* of vegetable drugs concentrated by evaporation to a soft solid. They are called "solid" extracts to distinguish them from fluid extracts. When employed, they are usually dispensed in pills or capsules. They have no uniform drug strength, and *extracts of opium* and *extract of nux vomica* are required to be assayed. The important extracts are:

Extract of Aloes (Extractum Aloes).
Extract of Cinchona (Extractum Cinchonæ).
Extract of Hyoscyamus (Extractum Hyoscyami).
Extract of Nux Vomica (Extractum Nucis Vomicæ).
Extract of Opium (Extractum Opii).

9. **Abstracts.—Abstracta.** These are a class of powdered extracts, formerly recognized by the U. S. P. (1880), prepared from the extracts by the addition of sufficient sugar of milk to make the product represent one-half *its weight* of the crude drug. The abstracts have a uniform relation to the drug in that *one grain represents two grains of the drug*, just as the fluid extracts have the uniform relation of representing the drug *volume* for *weight*. There are no official abstracts. An ideal abstract can be made from tincture of valerian, as the volatile oil in valerian does not permit of evaporation necessary for an extract. Abstract of valerian is one of the most practical preparations of the drug.

10. **Oleoresins.—Oleoresinæ.** There are *natural* and *pharmaceutic* oleoresins. The natural oleoresins have been elsewhere considered. The pharmaceutic oleoresins are semi-liquid extracts, obtained by exhausting oleoresinous drugs with ether. The ether extracts *fixed* and *volatile oils* from drugs, as well as *resins*. Oleoresins are not used in dentistry to any extent, but have been briefly considered here in order to make our classification complete. An example of an official oleoresin is:

Oleoresin of Capsicum (Oleoresina Capsici).

11. **Resins.—Resinæ.** Resins have previously been considered under the constituents of drugs. The official resins may be divided

into the 1. natural resins, 2. resins obtained from oleoresins by separating the volatile oil by distillation, and 3. pharmaceutic resins, prepared by *precipitation.* An example of an official resin is:

Resin of Podophyllum, May Apple (Resina Podophylli).

IV. MIXTURES OF SOLIDS.

The general class called *mixtures* of *solids* includes several subclasses of pharmaceutic preparations for internal use:

1. **Powders.—Pulveres.** These are impalpable mixtures of one or more active drugs, usually with some nearly inert substance, as sugar and aromatics. The nearly inert substance used to give bulk to official powders is called the *diluent.* The important powders are:

Compound Acetanilid Powder (Pulvis Acetanilidi Compositus).
Compound Powder of Chalk (Pulvis Cretæ Compositus).
Powder of Ipecac and Opium, Dover's Powder (Pulvis Ipecacuanhæ et Opii).
Compound Powder of Morphin, Tully's Powder (Pulvis Morphinæ Compositus).
Compound Effervescent Powder, Seidlitz Powder (Pulvis Effervescens Compositus).

2. **Effervescent Salts.—Sales Effervescentes.** These are granulated mixtures of salts with sugar and sodium bicarbonate and tartaric acid, which effervesce when the mixture is added to water and furnish agreeable aerated draughts. They are new additions to the U. S. P., and are highly useful in dentistry. Those official are:

Effervescent Caffein Citrate (Caffeina Citrata Effervescens).
Effervescent Lithium Citrate (Lithii Citrata Effervescens).
Effervescent Magnesium Sulphate (Magnesii Sulphas Effervescens).
Effervescent Potassium Citrate (Potassii Citrata Effervescens).
Effervescent Sodium Phosphate (Sodii Phosphas Effervescens).

3. **Confections.—Confectiones.** These are *flavored masses* wherein the adhesive substance is sugar and water, or honey, serving as a *vehicle* to mask the taste of the drug. Only two are official:

Confection of Rose (Confectio Rosæ).
Confection of Senna (Confectio Sennæ).

4. **Troches or Lozenges.—Trochisci.** These are confections made in various forms and dried. Most of the troches are intended

to influence the mucous membrane of the mouth and throat, and are useful preparations. The most important are:

Troches of Tannic Acid (Trochisci Acidi Tannici).
Troches of Ammonium Chlorid (Trochisci Ammonii Chloridi).
Troches of Krameria (Trochisci Krameriæ).
Troches of Potassium Chlorate (Trochisci Potassii Chloratis).
Troches of Sodium Bicarbonate (Trochisci Sodii Bicarbonatis).

5. **Masses.—Massæ.** These are plastic mixtures preserved in bulk and intended for forming into pills. There are two official:

Mass of Ferrous Carbonate, Vallet's Mass (Massa Ferri Carbonatis).
Mass of Mercury, Blue Mass (Massa Hydrargyri).

6. **Pills.—Pilulæ.** These are spherical, more or less soluble masses of medicinal substances rendered *cohesive*, *plastic*, and *firm* in consistence by the addition of some substance (usually inert), called *excipient*. The *kind* of excipient used varies with the nature of the medicinal substance. The various excipients employed are water, alcohol, glycerin, syrups, mucilage, glucose, glycerite of starch, or tragacanth, etc.

The following pills are important:

Pills of Aloes (Pilulæ Aloes).
Compound Cathartic Pills (Pilulæ Catharticæ Compositæ).
Pills of Carbonate of Iron, Blaud's Pills (Pilulæ Ferri Carbonatis).
Pills of Opium (Pilulæ Opii).
Pills of Phosphorus (Pilulæ Phosphori).

7. **Tablets.—Tabellæ.** These are small disks containing medicinal substances mixed with sugar and mucilage. They are a convenient form in which to administer potent remedies, such as the alkaloids, calomel, etc. Blank tablets, *i.e.*, those containing no medicinal substance, can be obtained and serve as a pleasant means of administering concentrated liquid preparations, such as the fluid extracts, by dropping from two to five minims of the preparation on the tablet. There are no official tablets.

V. PREPARATIONS FOR EXTERNAL USE.

This class of pharmaceutic preparations includes such products as are used for external medication. Liniments, oleates, and collodions are employed externally, but being *true solutions* are classified as such. The classification of the groups here considered is based upon

the *fusibility*, or melting-point, of the preparations, which is governed by the respective *vehicles* employed.

1. **Ointments.—Unguenta.** These are mixtures wherein medicinal substances are incorporated in a fatty vehicle. The *vehicles* used are: Benzolated lard, lard and wax or spermaceti in varying proportions, lard oil, olive oil and suet. Petrolatum and lanolin (wool-fat) are largely used in unofficial ointments. The following are important official ointments:

Ointment of Boric Acid (Unguentum Acidi Borici).
Ointment of Tannic Acid (Unguentum Acidi Tannici).
Ointment of Rose Water, Cold Cream (Unguentum Aquæ Rosæ).
Mercurial Ointment (Unguentum Hydrargyri).
Blue Ointment (Unguentum Hydrargyri Dilutum).
Iodin Ointment (Unguentum Iodi).
Iodoform Ointment (Unguentum Iodoformi).
Ointment of Phenol, Ointment of Carbolic Acid (Unguentum Phenolis).
Ointment of Zinc Oxid (Unguentum Zinci Oxidi).

Unofficial ointments in use are:

Ointment of Arsenic Trioxid, Devitalizing Paste (Unguentum Arseni Trioxidi).
Ointment of Europhen and Orthoform, Euroform Paste (Unguentum Europheni et Orthoformi).
Ointment of Camphor (Unguentum Camphoræ, N. F.).

2. **Cereates.—Cereata.** These are mixtures of medicated fats similar to ointments, but of firmer consistence because they contain wax, resin, or paraffin, which raises the melting-point. The important official cereates are:

Simple Cereate (Cereatum).
Camphor Cereate (Cereatum Camphoræ).
Cantharides Cereate, Blistering Cereate (Cereatum Cantharidis).

Important unofficial cereates are:

Compound Cereate of Camphor, Camphor Ice (Cereatum Camphoræ Compositum, N. F.).
Cereate of Bismuth Subnitrate, Beck's Cereate (Cereatum Bismuthi Subnitras).

3. **Suppositories.—Suppositoria.** These are variously shaped masses of medicated fats, intended to be inserted into the orifices of the body, as the rectum, vagina, urethra, or nostril. The usual vehicle

is oil of theobroma (cacao butter). Suppositories are expected to melt at body temperature. The only official one is:

Suppository of Glycerin (Suppositoria Glycerini).

4. **Plasters.—Emplastra.** Mixtures of solids having a fatty or resinous vehicle, and of such high melting-point as to be friable when cold, but rendered *adhesive* by the warmth of the body.

The *vehicles* of plasters are: Lead plaster; resinous substances, made adhesive by admixture with the medicinal ingredients, and simple plasters, such as isinglass. Important official plasters are:

Adhesive Plaster (Emplastrum Adhesivum).
Belladonna Plaster (Emplastrum Belladonnæ).
Capsicum Plaster (Emplastrum Capsici).

An unofficial plaster is:

Isinglass Plaster, Court Plaster (Emplastrum Ichthyocollæ).

5. **Papers.—Chartæ.** These are strips of unsized, white paper saturated or coated with some medicinal substance. They are intended to be moistened and applied as a plaster, or else to be burned and the fumes inhaled. Only one official:

Mustard Paper (Charta Sinapis).

6. **Poultices.—Cataplasmata.** These are semi-liquid preparations made by mixing such coarsely ground substances as flaxseed, elm-bark, or bread, with hot water or milk. They are spread upon cloth or filled into porous bags, and used for applying heat and moisture to the tissues, or for securing a local stimulant effect. Charcoal is sometimes added as an absorbent and mustard as a stimulant. Only one official:

Cataplasm of Kaolin (Cataplasma Kaolini).

7. **Fomentations.—Fomenti.** These are porous woolen cloths saturated with hot infusion or decoction of herbs, or other hot liquids or lotions (saturated solution of boric acid), and applied hot. They are useful preparations, but none official.

8. **Absorbent Cotton.—Gossypium Purificatum.** The hairs of the seed of cotton, freed from oil and resinous substances by treatment with alkalies and bleaching agents. These hairs represent microscopic ducts through which liquids are absorbed by capillary attraction. The absorbability of cotton, then, depends upon its purity,

or the freedom from oily and resinous substances. This is equally true of all other material used for bandages.

MISCELLANEOUS LIST OF UNOFFICIAL BANDAGES, SPLINTS, MEDICATED AND ANTISEPTIC DRESSINGS, AND MEDICATED GAUZES.

Bandages.—These are mechanical supports, serving also to keep wounds clean by absorbing and withdrawing such secretions as would otherwise prove irritating, and by protecting the wound from extraneous matter, thus promoting the process of healing.

Plaster-of-Paris bandages.—These are made by thoroughly incorporating a good quality of plaster-of-Paris (calcium sulphate) into linen bandages. After the bandage is adjusted, water is applied, when it sets in a few minutes.

Splints.—These are mechanical supports made from wood, metals (gold, platinum, lead, German silver, etc.), and vulcanite rubber. They serve the purpose of holding in proper position or alignment fractured bones and loosened teeth. The metallic splints are especially useful in orthodontia and pyorrheal treatment.

Medicated and Antiseptic Dressings.—These are made by saturating such materials as cotton, silk, wool, or asbetos fiber in a certain strength solution of the medicinal agent, or by incorporating the latter in powdered form. The fabric, which conveys the agent, simply serves as a vehicle for the medicinal or antiseptic drug. This means is largely employed in the application of medicines to the canals of teeth.

Medicated Gauzes.—The material used in making medicated gauzes is pure muslin gauze, which is thoroughly saturated with a certain strength solution of the medicinal substance desired, then forcibly expressed, after which it is ready for use. Medicated gauzes should be kept in tightly covered boxes or jars in a cool dry place. The following gauzes are in common use:

Borated Gauze.
Phenolized Gauze.
Iodoform Gauze.
Euroform Gauze.

METHODS OF ADMINISTERING OR APPLYING DRUGS.

The physiologic and therapeutic effect of remedies is often largely determined by the methods in which they are administered or applied; and it is a well-established principle that the nearer the remedy is

applied to the site of the disease the more effectual and safer is its use. Recognizing this principle, remedies should be applied locally as far as possible. There are many pathologic conditions, however, confronting the dentist which cannot be reached and acted upon favorably by the local application of medicines. It is, therefore, the plain duty of every practitioner of dentistry to so familiarize himself with drugs and their internal administration that he will be able to treat successfully any case which arises in his practice.

By the Mouth.—This is the original and most common method employed for the administration of the great majority of medicines. Drugs are given by the mouth for their local action on the mucous membrane and deeper seated tissues of the mouth, throat, stomach, or intestines or for the purpose of being absorbed. The absorption of drugs may take place from any part of the alimentary canal. Some powerful remedies are readily absorbed from the tongue. A dose of spirit of nitroglycerin, placed under the tongue, will produce its physiologic effect in from three to five minutes. Remedies intended to influence the mouth or throat are often given in the form of a troche or lozenge. When absorption of the remedy from the stomach is desired, it should be administered in solution or in such condition as to be acted upon by the gastric secretions and made soluble. The reaction of the gastric juice is acid, while the intestinal juices are alkaline. Any substance, therefore, soluble in either an acid or alkaline medium, is acted upon favorably by the secretions of the stomach or intestines. Such remedies as calomel, salol, and salophen, requiring an alkaline liquid for their solution, pass through the stomach practically unchanged, and are digested and absorbed almost entirely in the intestines. The general rule for administering remedies intended to be absorbed in the stomach is to give them on an empty stomach, that is, half an hour or an hour before meals. This rule should not be followed, however, in the case of remedies having a local irritant action, as potassium bromid or potassium iodid, etc. It is far better to give these remedies well diluted in water, and immediately after meals, so that their local effect is more or less avoided by becoming mixed with the food.

Hypodermic.—This method consists in injecting solutions of medicinal substances into the gum and subcutaneous tissues by means of the hypodermic needle and syringe, and is largely employed in dental practice. The method has many advantages, such as the great rapidity with which absorption is effected, for local medication, and the certainty of securing the action of the entire dose. The alkaloidal

salts, as cocain hydrochlorid, on account of their small bulk, are especially adapted for hypodermic use. The dose of a drug given hypodermically is generally about one-half that given by the mouth or stomach. There are several conditions wherein the hypodermic method of administering drugs is strongly indicated, viz.:

1. In conditions where the patient is unable to swallow, or where the stomach is unable to receive or retain medicines.

2. In conditions necessitating the immediate action of a drug or remedy, or where absolute certainty of the dose is desired.

3. In conditions where local medication is desired for the production of local anesthesia, for the relief of pain, as in neuralgia, or for stimulation of a deep-seated part.

The first two indications mentioned for this method of administering drugs are of interest to dentists in that the method is employed here in cases of emergency, as in collapse. The third indication is of prime importance, as it is employed every day in a busy practice for the purpose of injecting local anesthetics and other drugs for the mitigation of pain.

The factors to be remembered in using this method are:

1. Guard against septic infection.

2. Prevent the injection of air into a vein.

3. Prevent the injection of the medicine into a vein, unless in cases of emergency.

To *guard against septic infection,* it is necessary to have the hands and the field of operation as nearly sterile as they can be made and to have the hypodermic syringe, needle, and the solution absolutely sterile.

To *prevent injecting air into a vein,* it is essential that all of the air should be exhausted from the syringe before the injection is made. When the syringe is filled by drawing the solution into it, hold the point upward, tapping the side of the syringe gently to dislodge any air bubbles, then by pushing the piston until the solution escapes, the air is expelled. There is little danger of injecting air into a vein when the solution is injected into the gum tissue; nevertheless, it is well to avoid injecting air into the tissues, and when this method of drug administration is used other than with gum tissue, the danger is correspondingly increased. If air enters a vein it is carried directly to the right side of the heart, where by the action of the tricuspid valve it forms a foam with the blood, resulting in air-thrombosis, which might cause death.

Occasionally in an emergency it is desired to *inject the medicine into a vein* that it may be at once carried to the heart; but ordinarily this should be avoided. To unintentionally inject the entire quantity

into a vein might result in an overdose. By injecting slowly and holding the finger over the needle-point, one can readily guard against this danger. If the fluid accumulates, which should be easily detected by the finger, nothing need be feared; but if the fluid escapes readily and the accumulation cannot be detected, one may suspect that a vein has been punctured. In this case the needle should be slightly withdrawn and the injection continued.

The Hypodermic Syringe.—There are many varieties of hypodermic syringes on the market. It is difficult to thoroughly sterilize the old-style glass barrel and leather-covered piston syringe, and, although it has the advantage of permitting a view of the fluid or air within the barrel, the ease with which the all-metal syringe can be sterilized and its ever-readiness for use make this style of syringe far preferable. The syringe should be of sufficient size to permit considerable pressure in making the injection. There are a variety of needles also. The operator should select and keep on hand the kinds which best meet his daily need.

Technic of the Injection.—The method of injecting medicines hypodermically differs somewhat with the site of application; therefore, it will be discussed under different headings:

1. Through the skin into the cellular tissue of the body.
2. Through the mucous membrane into the gum tissue and pericemental membrane.
3. Through the tooth structure into the pulp tissue.

In injecting drugs hypodermically *through the skin* it is essential to guard against the dangers incident to this method of administering medicine. The solution should be sterile to begin with, the syringe (all metal) and needle may be sterilized by boiling, the hands by washing with green soap and followed with an application of alcohol (60 to 70 per cent.), 1–1000 solution of mercuric chlorid, or 1–500 solution of sublamin; the site of application may be sterilized in the same manner as the hands. The selection of the site for making the injection depends upon the circumstances of the case. It may be made upon any accessible part of the body, usually, however, the arm or lumbar region of the back. After exhausting the air from the syringe, hold firmly in the right hand, and with the left grasp the skin at the selected site. The needle should now be pushed quickly through the skin at nearly right angles to the surface, and should penetrate quite deeply. The injection should be made slowly and with the forefinger of the left hand determine whether it is causing distention of tissue or escaping rapidly.

The dentist, as has been intimated, is particularly interested in the technic of injecting drugs hypodermically *through the mucous membrane* and into the gum tissue for the purpose of producing local anesthesia. Before undertaking any surgical operation the mouth should be rinsed, or, better, sprayed with an antiseptic solution. The solution, syringe, needle, and hands of the operator should be sterilized as before. In sterilizing the field of operation here, alcohol is an excellent agent to use. The immediate point through which the needle passes can be touched with a drop of phenol (95 per cent.), using a sharp pointed glass rod or a toothpick. This further sterilizes the spot and slightly anesthetizes it; thus the initial pricking of the needle is scarcely felt. This is far better than the customary practice of dipping the needle point into phenol, with the liability of getting some of the agent on the barrel of the syringe, and, if unnoticed, on the patient's lip. The left hand is used in holding the lip and cheek out of the way, and with the syringe in the right hand, held at an angle of about forty-five degrees to the long axis of the tooth, the mucous membrane is punctured, having the bevel of the needle facing the tooth. A drop of the fluid is now deposited, and after waiting just a moment, further injection is painless. With the left forefinger pressure can be made over the needle-point, thus forcing the fluid into the tissues and anesthetizing the part with a minimum amount of solution. If the needle is ultimately passed through the gum and enters the pericemental membrane at the extreme border of the alveolar process, in the region of the so-called dental ligament, the solution, with a strong syringe, can often be forced through the membrane, completely anesthetizing it to the apex of the root. This is generally much more satisfactory than making the injection nearer the apex of the root and endeavoring to force the solution through the bone lamella.

The forcing of local anesthetic agents *through the tooth structure and into the pulp* is known as **pressure anesthesia** and is elsewhere considered.

Epidermic or Inunction.—This method consists in applying medicinal substances, dissolved in fatty vehicles, to the unbroken skin when absorption of the remedy is fairly well brought about, especially if friction be used in their application. Ointments are largely employed in this manner.

Intravenous.—This method is used in great emergency where it is desired to inject a stimulating or restorative agent directly into a vein. Normal saline solution (6 parts of sodium chlorid in 1,000 parts of sterile water—6 grams in 1,000 c.c.) is the remedy mostly employed

in this manner. The solution is intended to correspond to blood serum in salinity, and is given intravenously in cases of copious hemorrhage, or in collapse.

Cataphoresis.—This method consists in the introduction of drugs in molecular form into tooth structure or living tissue by means of the electric current. The positive-pole applicator is saturated with a concentrated solution of the drug and placed into a cavity in the tooth being treated, or directly over the part to be medicated, the negative pole being placed somewhere on the patient's body, usually held in the hand by means of a moist sponge. This method, with cocain hydrochlorid as the drug, has been used to obtund sensitive dentin and to anesthetize the dental pulp for the purpose of its painless removal. The method will, therefore, again be considered more in detail later.

By the Rectum.—This method is employed for the administration of both medicines and food, whenever, on account of inability to swallow or persistent vomiting, the mouth or stomach route cannot be used. Absorption through the rectum is not nearly so rapid as through the stomach, hence to accomplish the same result it generally requires twice the dose by the rectum that would be necessary by the mouth, and solution of the drug should be assured before it is administered, unless a local effect is intended. For local medication suppositories are largely employed.

Inhalation.—This method can only be employed for volatile drugs or finely-atomized liquids. Volatile drugs are rapidly absorbed from the respiratory tract, and this method is largely used in dental practice for the administration of such drugs as nitrous oxid, chloroform, and ether, when the general analgesic or general anesthetic effect is desired. The stimulating effect of such drugs as ammonia and amyl nitrite is also produced by inhalation. When it is desired to influence directly the mucous membrane of the mouth and respiratory tract, medicated vapors and sprays are often employed.

CONDITIONS MODIFYING THE ACTION AND EFFECT OF DRUGS.

There are many conditions or circumstances which influence and modify the action and effect of drugs, chief of which are the age of the patient, sex, race, size, temperament, disease, temperature, habit, idiosyncrasy, method and time of administration, preparation of the drug, and dose.

Habit.—The tissues of the body can be induced to tolerate many

drugs by their continuous administration. This is particularly true of opium and cocain. It is not definitely known just how this condition is brought about, but it is believed to be largely due to a change in the tissues themselves whereby they are rendered less suitable to the influence of the drug. There is a crying demand to-day for *painless dentistry*, and most dental operations can be made practically painless by the judicious use of narcotic drugs, especially cocain. Therefore, a word of caution here regarding the danger of forming the drug-habit will not be out of place. This habit is far more common than is generally known. It is the duty of every dentist to employ such reasonable measures as will mitigate pain, but he should constantly guard his patient, as well as himself, against the formation of the drug-habit.

Idiosyncrasy.—This is a peculiar susceptibility or insusceptibility of one or more of the tissues of the body to the influence of certain drugs for which no explanation can be found. Less than 1/4 of a grain of calomel has been known to induce salivation, causing an inflammation in the pericemental membrane and teeth sore to pressure. With some individuals the smallest dose of quinin will produce a diffuse erythematous rash. Many patients have an idiosyncrasy for cocain, the smallest amount causing all of the toxic symptoms characteristic of the drug. Other patients have what may be called a presupposed idiosyncrasy, for cases are on record where the patient had all the symptoms of cocain-poisoning when only distilled water had been hypodermically injected, the patient, however, thinking cocain had been used.

One form of idiosyncrasy consists in the failure of the individual to react to the ordinary dose of the drug, and this particular form is called **Tolerance.**

Cumulative Effect.—This is another phenomenon of drugs caused by their prolonged administration when sudden and oftentimes a severe effect is produced, owing to the accumulation of the drug in the tissues of the body. Cumulative action may occur along with tolerance.

Dosage.—Under this heading can be discussed most of the conditions which modify the effect of drugs not previously considered, for whatever modifies the effect of drugs must also necessarily influence dosage. In regard to dosage Butler[1] says: "Common sense ought long since to have told us that the doses prescribed in text-books are only based upon experience in certain cases, or upon experimentation made upon animals. From such data, however, the first author who wrote upon the posology of different substances started, and others have

[1] Text-book of Materia Medica, Therapeutics, and Pharmacology, p. 46.

simply copied after the first. If any fact went beyond the well-defined limits, it was wont to be explained by the defective quality or method of preparation of the drug, or by an idiosyncrasy so rare that one would not even take the pains to investigate the matter, and see if it were really less rare than had been believed." While there is perhaps a *maximum* and a *minimum* dose for the various drugs, the dose of a remedy should be governed largely by the conditions found at the time the diagnosis is made and the medicine prescribed, taking into consideration the various circumstances which influence the action and effect of drugs.

The age of a patient must be taken into account in the internal administration of drugs. Children ought to receive much smaller doses than adults. Young calculates the dose for a child according to the following formula: Divide the age by the age + 12, the fraction obtained is taken as the proportion of the adult dose required. Thus, for a child four years old, the dose would be ($\frac{4}{4+12}=$) 1/4 of the adult dose; for a child twelve years old ($\frac{12}{12+12}=$) 1/2 of the adult dose.

In regard to the **sex,** women require somewhat smaller doses than men. During *pregnancy*, purgative drugs, or preparations of ergot used frequently in dental practice in cases of hemorrhage after extraction, have to be used with the greatest care, because purgatives induce congestion of the pelvis, and ergot acts directly upon the muscular walls of the uterus, causing contraction, either of which conditions may lead to abortion. Many drugs also pass from the mother to the child, and this should be remembered, as quantities which are insufficient to poison the former may have serious effects upon the latter. During *lactation*, it should be borne in mind that many active drugs may be excreted in the milk, and may either act on the child or render the milk distasteful to it.

Pathologic conditions very often modify the effects of drugs to a considerable extent, and in a way which pharmacologists at present cannot explain. As an example of this, the antipyretics reduce the temperature in fever, but have no effect on it in health; bromids lessen the convulsions in epilepsy, or during the teeth-erupting period in children, but have much less effect in depressing the brain in normal persons. Strange as it may seem to the student or inexperienced practitioner, the **climate** or **temperature** has a controlling influence on the action and effects of drugs, as well as on pathologic conditions, which fact has been demonstrated by clinical experience.

The method and time of administration also have some influence on the effects of drugs. It has been mentioned elsewhere that the

nearer the site of the disease the remedy is applied the more effectual and safer is its use. It is also true that the body is generally more resistant in the morning than in the evening, especially in the case of hypnotic drugs; thus a dose of chloral hydrate, for example, which may have little or no effect in the morning when the brain is clear and active, induces sound sleep when given in the evening, because the brain now is already fatigued and depressed.

CLASSIFICATION OF MEDICINES.

In their attempt to keep pace with the advancement of knowledge, writers upon, and teachers of, Materia Medica, Pharmacology, and Therapeutics have devised, from time to time, various systems of classification of drugs and remedial agents. The unsettled state of knowledge regarding normal physiologic processes and of the physiologic action of remedies upon pathologic conditions which they are expected to correct, are sufficient reasons, in the author's opinion, for stating that therapeutics is far from being an exact science. At this time, therefore, no really scientific classification of these substances is possible. It is imperative, however, as an aid to the student, that some system of classification be followed, and, inasmuch as the tendency in modern therapeutics is along rational lines, *i.e.*, administering or applying the remedy because of its known pharmacologic action, a system of classification will be followed by which drugs will be divided into local and general remedies, and grouped, so far as possible, according to their physiologic action and therapeutic application. It is important, however, that the student familiarize himself at the beginning of the study of drugs and their uses with the definitions of *remedies* with reference to their action upon the tissues, organs, and functions of the body. Therefore, as an appropriate introduction to that part of this work devoted to *drugs* proper, brief definitions of remedies, alphabetically arranged, are here inserted, together with practical examples of each.

DEFINITIONS OF REMEDIES.

Antacids.—These are agents which neutralize acids by reason of their alkaline or basic properties. Examples are:

Sodium Bicarbonate.
Solution of Calcium Hydroxid (Lime-water).
Magnesium Hydroxid (Milk of Magnesia).

Alteratives.—Agents that *alter* or counteract morbid conditions by promoting metabolism or the processes of nutrition. Examples are:

Potassium Iodid.	Arsenic.
Mercury.	Cod-liver Oil.

Analgesics or Anodynes.—These are agents which relieve pain either by direct depression of the centers of perception and sensation in the cerebrum or by impairing the conductivity of the sensory nerve fibers. Examples are:

Opium.	The Bromids.

Butyl-chloral Hydrate.

Anesthetics.—These are agents which temporarily destroy sensation. They are divided into two classes, *local* and *general.* A local anesthetic abolishes sensation in a part, while a general anesthetic abolishes all sensation and induces unconsciousness. Examples are:

Local anesthetics.	*General anesthetics.*
Cocain Hydrochlorid.	Nitrous Oxid.
Eucain Hydrochlorid.	Chloroform.
Ethyl Chlorid spray.	Ether.

Antagonists.—These are agents which directly oppose each other in some or all of their pharmacologic actions. Advantage is taken of drugs which antagonize each other in cases of *poisoning.* Important examples are:

Strychnin and Cocain.	Atropin and Morphin.

Caffein and Cocain.

Anthelmintics.—These are agents which destroy (vermicides) or expel (vermifuges) intestinal worms. Examples are:

Pepo (Pumpkin-seed).	Oil of Turpentine.

Thymol.

Antipyretics.—These are drugs or remedies which reduce the body temperature when abnormally high. Examples are:

Aconite.	The Coal-tar Products:
Quinin.	Antipyrin. Acetanilid.
	Phenacetin.

Antiseptics.—These are agents which inhibit the growth of microorganisms. Examples are:

Oil of Cloves.	Benzoic Acid.
Phenol (5 per cent. solution).	Sodium Borate (Borax).
Boric Acid.	Glycerin.
Alcohol (20 per cent. solution).	Betanaphthol.

Antispasmodics.—These are agents which control spasms and lessen states of general nervousness. Examples are:

Camphor. Compound Spirit of Ether (Hoffmann's Anodyne).
Valerian.

Astringents.—These are agents which contract or condense tissue. Examples are:

Alum.	Zinc Phenolsulphonate.
Tannic Acid.	Zinc Iodid.
Bismuth Subnitrate.	Silver Nitrate.
Zinc Chlorid.	Copper Sulphate.

Bleachers.—These are agents used to restore the color of tooth-structure. Examples are:

Sodium Dioxid.	Alphozone.
Hydrogen Dioxid.	Chlorin.

Sulphurous Acid.

Carminatives.—These are agents which promote the expulsion of gas from the stomach. Examples are:

Capsicum.	Pepper.
Mustard.	Cinnamon.
Ginger.	Cardamom.

Cathartics.—These are agents used to produce evacuation of the bowels. Cathartic drugs are classified according to the intensity of their action. Thus those that are mild in action and produce a nearly normal stool are called *laxatives.* Those more powerful, usually producing more copious stools, are termed *purgatives.* Those which produce a watery evacuation of the bowels are called *hydragogues.* Those which gripe, having a violent action, are called *drastics.* Examples of each class follow:

Laxatives.
Tamarind.
Cascara Sagrada.
Manna.
Honey.
Figs.
Prunes.

Hydragogues.
Magnesium Sulphate.
Sodium Sulphate.
Potassium and
Sodium Tartrate (Rochelle Salt).
Sodium Phosphate.
Magnesium Citrate.

Purgatives.
Aloes.
Senna.
Castor Oil.
Calomel.
Rhubarb.
Blue Mass.

Drastics.
Croton Oil.
Colocynth.
Gamboge.
Jalap.
Podophyllum.

Demulcents.—These are substances largely of a mucilaginous nature, which soothe and protect the parts to which they are applied. Examples are:

Acacia.	Marshmallow.
Licorice.	Starch.
Sassafras Pith.	Flaxseed.
Slippery Elm.	White of Egg.

Dentifrices.—These are medicated powders or pastes applied with a suitable brush to cleanse the teeth and gums. Precipitated chalk (calcium carbonate) is the base of all dentifrices. For examples see Practical Therapeutics, p. 252.

Deodorants.—These are agents which destroy offensive odors. Examples are:

Formaldehyd.	Potassium Permanganate.
Chlorin Gas.	Charcoal.
Hydrogen Dioxid.	Sulphurous Acid

Diaphoretics or Sudorifics.—These are agents which promote the secretion of sweat. When the action of the remedy is such that the perspiration stands in beads upon the surface, it is called *sudorific*. Examples are:

Pilocarpus (Pilocarpin)	Ammonium Acetate.
Dover's Powder.	Spirit of Nitrous Ether.

Disinfectants or Germicides.—These are agents which destroy microorganisms and their spores. Examples are:

Mercuric Chlorid.	Urotropin.
Formaldehyd.	Hydrogen Dioxid.
Cresol.	Potassium Permanganate.
Phenol.	Silver Compounds.
Thymol.	Betanaphthol.
Heat.	Chlorin Gas.

Diuretics.—These are agents which increase the flow of urine. Examples are:

Potassium Salts.	Effervescent Salts.
Lithium Salts.	Spirit of Nitrous Ether (Sweet Spirit of Niter).

Emetics.—These are agents which produce vomiting. Examples are:

Ipecac.	Alum.
Tartar Emetic.	Mustard.
Zinc Sulphate.	Apomorphin.
Copper Sulphate.	Tepid Water, in quantity.

Emollients.—These are substances which protect, soften, and relax the tissues to which they are applied. Examples are:

Hot Fomentations.	Linseed Oil.
Poultices.	Petroleum.
Lard.	Cacao Butter.
Lanolin.	Glycerin.
Olive Oil.	Almond Oil.

Escharotics or Caustics.—These are agents which destroy the tissues upon which they act. Examples are:

Mineral Acids.	Osmic Acid.
Caustic Alkalies.	Zinc Chlorid.
Phenol.	Sodium Ethylate.
Arsenic Trioxid.	Mercuric Chlorid.
Trichloracetic Acid.	Silver Nitrate.

Actual Cautery.

Expectorants.—These are agents which modify the secretion of mucus from the mucous membrane of the air-passages and facilitate its expulsion. Examples are:

Ammonium Chlorid.	Squill.
Eucalyptus.	Ipecacuanha.
Potassium Citrate.	

Hypnotics or Somnifacients.—These are agents which produce sleep. Examples are:

Chloral Hydrate.	Trional.
Butyl-chloral Hydrate.	Paraldehyd.
Sulphonal.	The Bromids.

Opium (and Alkaloids).

Irritants.—These are agents which, when applied to the skin or mucous membrane of the mouth, cause active hyperemia or inflammation. When they are applied not simply for their local action, but to influence favorably a deep-seated part which is diseased, they are called **counter-irritants.** Irritants are largely used for the latter purpose in dental practice. Examples are:

Iodin.	Aconite.
Mustard.	Chloroform.
Capsicum.	Volatile Oils.
Camphor.	Menthol.

Mydriatics.—These are agents which produce dilatation of the pupil of the eye. Examples are:

Atropin.	Homatropin.
Hyoscyamin.	Cocain.

Anesthetics (late in their action).

Myotics.—These are agents which produce contraction of the pupil of the eye. Examples are:

Physostigma, Eserin.
Opium, Morphin.
Anesthetics (early in their action).

Narcotics.—These are agents which produce stupor. Examples are:

Opium (and Alkaloids).
Alcohol.
Chloroform.
Ether.

Restoratives.—These are agents, somewhat similar to alteratives, which promote constructive metamorphosis. Restoratives include:

FOODS, HEMATICS, AND TONICS.

Foods are substances which, when introduced into the body, supply material to renew some structure or to maintain some vital process. They differ from medicines in that the latter modify vital processes, but furnish no material to sustain such.

Hematics are medicines which increase the hematin in the blood, and enrich the red blood-corpuscles. The compounds of iron are the principal hematics.

Tonics are agents which improve the tone and give strength and energy to the tissues. Among the tonics are:

Iron and Compounds.
Phosphorus.
Calcium Phosphate.
Hypophosphites.
Cod-liver Oil.
Nux Vomica.
Cinchona.
Arsenic.

Sedatives.—These are agents which exert a soothing influence on the system by lessening functional activity and diminishing pain. They have been largely considered in other classes of remedies, as: *General sedatives* include anesthetics and narcotics. *Nervous sedatives* include the bromids, tobacco, etc.

Sialogogues.—These are agents which stimulate the salivary and buccal mucous glands, increasing the secretion and flow of saliva and buccal mucus. Holding the mouth open, as in dental operations, changes the character and flow of the mouth secretions. Examples of drugs producing this effect are:

Pilocarpus (Jaborandi).
Mercurials.
Echinacea, Echafolta.
Iodin Compounds.
Tobacco.
Potassium Chlorate.

Stimulants.—These are agents which increase the activity of an organic function or process. When applied to medicinal agents the term is used in various senses, for different agents stimulate the functional activity of the various organs of the body. As examples we have:

Cardiac.	*Respiratory.*	*Gastric.*	*Restorative.*
Strychnin.	Atropin.	Gentian.	Normal Saline Solution.
Digitalis.		Bitter Tonics.	
Caffein.			
Alcohol.			

Styptics and Hemostatics.—These are agents which arrest hemorrhage. When the agent is applied locally it is called a *Styptic;* when administered internally it is called a *Hemostatic.* Examples are:

Styptics.	*Hemostatics.*
Acids.	Ergot.
Alum.	Gallic Acid.
Ferric Subsulphate.	Hamamelis.
Adrenalin Chlorid.	
Cauterization.	

DRUGS.

As stated elsewhere, an effort will be made to divide drugs into *local* and *general remedies*, and group them, so far as possible, according to their physiologic action and therapeutic application. Those drugs which are largely applied *locally* in dental practice will first be considered.

LOCAL REMEDIES.

ANTACIDS.

Antacids are agents which neutralize acids by virtue of their alkaline or basic property. All acids, whether mineral or organic, have a destructive action on the tooth-structure. Acids are found in the mouth as a result of the fermentation of carbohydrate food-stuffs, from eructations of the stomach, and from perverted buccal mucous glands. Agents which are capable of neutralizing acids, therefore, have an important rôle to play in the broad field of *oral prophylaxis.* They should form the base of all dentifrices and enter as an essential constituent into nearly all mouth-washes. The most important antacids are:

Calcium Carbonate.
Lime-water.
Sodium Bicarbonate.
Sodium Borate (Borax).
Magnesium Oxid.
Soap.

CALCII CARBONAS—U. S. P.

(Calcium Carbonate; Chalk; $CaCO_3$.)

There are two official forms of chalk: **Precipitated calcium carbonate** and **prepared chalk.** The former is made by mixing aqueous solutions of calcium chlorid and sodium carbonate, the resulting precipitate of calcium carbonate being purified. The latter is native calcium carbonate, freed from most impurities by elutriation (washing). Both forms occur as a white, amorphous powder, odorless and tasteless, and permanent in the air, nearly insoluble in water and insoluble in alcohol.

Therapeutics.—Chalk is an antacid and mild astringent. It is an excellent antacid when the acidity of the fluids of the mouth are due to eructations from the stomach. It may be prescribed as an *antidote* in general poisoning by any of the *mineral acids* or by *oxalic acid,*

care being taken to avoid the rapid evolution of large quantities of gas (CO_2). Because of its antacid properties and its almost insolubility, it enters into the composition of nearly all dentifrices, forming the base of most *tooth-powders* and *pastes.*

LIQUOR CALCIS—U. S. P.

(Solution of Calcium Hydroxid; Lime-water; $Ca(OH)_2$.)

Lime-water is a saturated solution of pure calcium hydroxid in water. The liquid should be clear and colorless, without odor, and having a saline and feebly caustic taste. It should contain not less than 0.14 per cent. of calcium hydroxid. When administered internally the dose is from 1/2–2 fl. oz. (15.0–60.0 c.c). A useful official preparation is linimentum calcis (equal volumes of lime-water and linseed oil).

Therapeutics.—All cases where cows' milk is the chief article of diet, as in the artificial feeding of children, lime-water should be added to the milk to prevent the formation of hard curds in the stomach. In cases of *obstinate vomiting,* as in pregnancy, when the vomiting or eructations are due to a high degree of acidity, it is a useful remedy. In *chronic catarrh* with an excessive secretion of mucus, lime-water diluted with two-thirds cinnamon water, to which a small amount of alcohol is added, can be used as a spray and for rinsing the mouth and brushing the teeth, gums, and tongue with gratifying results. The official liniment, called also Carron Oil, is employed as a soothing application for *burns* and *scalds.*

SODII BICARBONAS—U. S. P.

(Sodium Bicarbonate; $NaHCO_3$.)

Sodium bicarbonate is a white, opaque powder, without odor, and having a cooling and slightly alkaline taste. It is freely soluble (12 parts) in water and insoluble in alcohol. The dose is from 5–30 gr. (0.3–2.0 gm). An important official preparation is:

Trochisci Sodii Bicarbonatis, (containing 2 1/2 gr. (0.18 gm.) each).

Therapeutics.—Sodium bicarbonate is extensively used to neutralize the excess of hydrochloric acid or abnormal acids in the stomach. Given in the form of a troche an hour or two before meals, it allays the burning pain, eructations, and palpitations caused by the *acids of fermentation.*

Sodium bicarbonate is often applied externally as a sedative dressing for *superficial burns.* A 5 to 10 per cent. solution has been

used in cases of *thrush* with excellent results. It is an ingredient of the popular Dobell's solution (see page 130) and used as an antacid or detergent in many mouth-washes. Sodium bicarbonate is added to the water in which instruments are boiled for sterilization to prevent the latter from rusting. Sodium carbonate and borax are also used for this purpose. When acids are employed in root-canals, they should subsequently be neutralized with some antacid, and nothing is better than a solution of sodium bicarbonate. The powder is used by direct application to lessen the hypersensitiveness of dentin when due to acidity. In the treatment of pyorrhea and oral prophylaxis, the teeth, oftentimes after the scaling and polishing, are extremely responsive to thermal changes, especially where the gums have receded, exposing the cementum. This can be controlled by warm solutions of the drug.

Incompatibilities.—Sodium bicarbonate is incompatible with acids, metallic salts, and alkaloids.

SODII BORAS—U. S. P.

(Sodium Borate; Sodium Biborate; Borax; $Na_2B_4O_7.10H_2O$.)

Borax occurs in colorless crystals or white powder, inodorous, and of a sweetish alkaline taste. It is soluble in about 16 parts of water and 1 part of glycerin, and is insoluble in alcohol. The dose is from 5–20 gr. (0.3–1.3 gm.). An official preparation for external use containing borax is:

Unguentum Aquæ Rosæ (Cold Cream).

Therapeutics.—The alkaline and antiseptic properties of borax make it a useful drug. It is a valuable ingredient in mouth-washes possessing the above qualities, and can be used freely in saturated solution (6 1/4 per cent.) in cases of *stomatitis* and in *thrush*. In the latter disease, which generally occurs in the mouths of infants where it is impracticable to use a mouth-wash to advantage, a saturated solution in glycerin, made by dissolving the drug in hot glycerin, can be employed. This thick, sweet solution should be applied by means of a swab to the mucous membranes of the infant's mouth. A saturated solution in a 10 per cent. formaldehyd solution makes an excellent sterilizing fluid for small instruments. The borax prevents the formaldehyd from attacking the metal. A good collyrium (eye-water) can be made by adding 2 per cent. of borax to a saturated solution of boric acid.

Incompatibilities.—Borax is incompatible with acids, metallic salts, and alkaloids, and glycerin slowly converts it into boric acid.

MAGNESII OXIDUM—U. S. P.

(Magnesium Oxid; Light Magnesia; Calcined Magnesia; MgO.)

Light magnesia is a very light, white, odorless powder, having an earthy-like taste. It is practically insoluble in water, and insoluble in alcohol, but chemically soluble in dilute acids. The dose is from 30–60 gr. (2.0–4.0 gm.). An important official preparation is:

Ferri-hydroxidum cum Magnesii Oxido.

Therapeutics.—Magnesia is partly converted by the acids of the stomach into soluble salts that act as laxatives; hence, when internally administered, the antacid properties of magnesia are combined with those of a mild aperient or laxative. The preparation of ferric hydrate with magnesia has long been recognized as an efficient antidote in *arsenical poisoning.* Other compounds of magnesia, recognized by the U. S. P. are heavy magnesia (magnesia oxid—3 1/2 times as heavy as light magnesia) and magnesium carbonate. Both have practically the same properties and uses as light magnesia. Magnesium carbonate, however, should be used cautiously when there is much acid in the stomach on account of the unpleasant eructations of gas (CO_2). Magnesium carbonate, being cheap and insoluble, is often substituted for talc or precipitated calcium phosphate in the preparation of the medicated waters. The suspended precipitate of magnesium hydrate, commercially called milk of magnesia, is a useful antacid. In cases of erosion of the teeth, in pregnancy, and other conditions wherein the mouth secretions are acid in reaction, it can be used to advantage by coating the exposed tooth-surfaces with it. Its gelatinous consistence causes it to adhere and remain for a considerable length of time, especially if applied on retiring at night when the jaws and buccal tissues are at rest.

SAPO—U. S. P.

(Soap; White Castile Soap.)

The only official **soap** is white castile soap, made by boiling olive oil with sodium hydroxid. Any fat boiled with sodium or potassium hydroxid will form soap. Hard soap is a sodium soap, soft soap is a potassium soap. White castile soap should be hard, but easily cut when fresh, and easily pulverized when dry, and free from rancid odor. It has a rather unpleasant taste and an alkaline reaction, hence it is an antacid, soluble in water and in alcohol.

A useful preparation is:

Linimentum Saponis Mollis—U. S. P. (Liniment of Soft Soap, Tincture of Green Soap.)

Therapeutics.—White castile soap is alkaline in reaction and somewhat antiseptic, possessing detergent properties to a marked degree. The greatest value of soap lies in its power to dissolve fats. Advantage is taken of this fact in bleaching teeth as will be explained in Practical Therapeutics (page 341). White castile soap is chiefly used in dental practice as a constituent of dentifrices, both tooth-powders and tooth-pastes. The preparation should not contain more than about 25 per cent.; for, in greater quantities, too much suds is formed in the mouth by its employment. The preparation known as tincture of green soap is a valuable toilet article for dentist's hands.

Incompatibilities.—Soap is incompatible with all acids and with earthy and metallic salts. It is precipitated in hard water (containing earthy salts) as an insoluble soap.

ANTISEPTICS, DISINFECTANTS, AND DEODORANTS.

The term **antiseptic** has been defined elsewhere as applying to that class of remedies which inhibit or have a restraining influence on the life and activity of microorganisms. The terms **disinfectant** and **germicide** have been previously referred to as applying to that class of remedies which destroy microorganisms and their spores. Some authors have endeavored to distinguish between the two latter terms, using the term germicide in the sense that the agent simply kills the germ, and disinfectant in the sense that the agent not only kills the germ, but also acts upon the noxious products of putrefaction and fermentation. As a matter of fact, this distinction is largely theoretical, for there are few agents which, if used in sufficient strength to kill the germ, will not also act upon and thus destroy or remove the by-products of germ-growth. In this work, therefore, the term disinfectant will be used in preference to the term germicide, and for the reason given. A **deodorant** is an agent which destroys offensive odors, and inasmuch as the odor generally comes from the noxious products of putrefaction, the deodorization results from true disinfection. Therefore, deodorants will be discussed conjointly with antiseptics and disinfectants.

Many agents belong to both the antiseptic and disinfectant classes of remedies, depending upon the strength in which they are employed. In weak solutions they act as antiseptics; in strong solutions, as disinfectants. These two classes of remedies are among the most important classes employed in dental practice, and it is well that the student should understand at the outset the significance of these remedies.

In all surgical work the ideal condition sought is the absence of disease-producing germs (asepsis), rather than to depend upon the chemic destruction of them at the time of operating. With this end in view, the instruments are sterilized by boiling, and the site of operation as well as the operator's hands are disinfected by washing in certain solutions. Strictly speaking, infected animal tissue cannot be sterilized by employing disinfectants. An ideal disinfectant would be an agent which, employed in certain strength solution in a septic process or disease, would kill the disease-producing germ and destroy or remove the poisonous by-products without acting deleteriously upon the animal cell. But bacteriologists inform us that the cell-wall of a vegetable cell (bacteria) is less permeable to disinfecting agents than is the cell-wall of the animal cell. Therefore, in our present state of knowledge we should not employ disinfectants in our effort to kill the germ when its habitat is among living animal cells. It becomes necessary, then, to attack these germs in another manner. This can be done by the use of certain antiseptic agents which check the growth and activity of the germs, cripple them as it were, and which agents also are just sufficiently irritating to the animal cells as to produce stimulation. This stimulating or awakening process on the part of the animal cells will cause the latter to attack and destroy the already crippled vegetable cells, thus bringing about nature's method of sterilization.

When the germs which we are endeavoring to destroy are among the contents of a putrescent root-canal, for example, surrounded by hard tooth-structure and removed from live animal tissue, the problem presents an entirely different aspect. Here true disinfectants can be employed. Because, then, a remedy will destroy microorganic life in a certain length of time in a test-tube, or in a putrescent root-canal, is no criterion that the remedy, as such, can be used for disinfecting the soft tissues of the mouth.

The chief antiseptics are:

Boric Acid.
Borax.
Benzoic Acid.
Salicylic Acid.
Salol.
Salophen.
Sodium Salicylate.
Iodin and Compounds.
Betanaphthol.
Resorcin.
Silver Compounds.*

Many Volatile Oils:
  Oil of Cajuput.
  Oil of Cinnamon.
  Oil of Cloves.
  Oil of Eucalyptus.
  Oil of Peppermint.
  Oil of Thyme.
Charcoal.
Calendula.
Arnica.
Myrrh.

Ozone and Oxygen.

The chief disinfectants are:

Mercuric Chlorid (Discussed under Mercury in *Alteratives*).
Phenol.
Cresols.
Creasote.
Formaldehyd.
Urotropin.
Hydrogen Dioxid.
Potassium Permanganate.
Chinosol.
Kresamin.
Heat.

ACIDUM BORICUM—U. S. P.

(Boric Acid; Boracic Acid; H_3BO_3.)

Boric acid occurs in transparent, colorless, pearly scales or crystals, nearly colorless and of a somewhat bitterish taste, and slightly unctuous to the touch. It is soluble in about 25 parts of water, 15 parts of alcohol, and 10 parts of glycerin. When given internally the dose is from 5 to 20 gr. (0.3–1.3 gm.).

All of the official preparations are valuable in dental practice. They are:

Liquor Antisepticus, Antiseptic Solution (contains 2 per cent. of boric acid, 0.1 per cent. each of benzoic acid and thymol, 25 per cent. of alcohol, and minute quantities of eucalyptol, oil of peppermint, oil of gaultheria, and oil of thyme, in an aqueous vehicle).
Glyceritum Boroglycerini, Glycerite of Boroglycerin (contains 31 per cent. of boric acid in glycerin).
Unguentum Acidi Borici, Ointment of Boric Acid (10 per cent.).

Physiologic Action.—In quantities generally employed by dentists, boric acid produces no appreciable symptoms. It is rapidly absorbed and rapidly eliminated by the saliva, perspiration, feces, and urine—the bulk of it escaping in the urine within twenty-four hours after its administration. It is not a drug to be used indiscriminately, for repeated external applications have led to the same train of symptoms as those observed following the continued internal administration of the drug. The term *borism* has been applied to this condition, and the most important phenomena are digestive disturbances, dryness of the skin and mucous membranes, and a tendency toward certain rashes. The drug has been used as a preservative of milk and foods, and there is a difference of opinion among investigators as to whether or not boric acid has a deleterious action when so used.

Therapeutics.—Boric acid is a constituent of many mouth-washes. It is largely employed in a saturated aqueous solution (4 per cent.) as an antiseptic and stimulating wash. Because of its

nonirritating properties it can be applied to the most sensitive tissue. A good collyrium (eye-wash) can be made by adding 10 gr. (0.6 gm.) of borax to 1 fl. oz. (30.0 c.c.) of the saturated solution of boric acid. Lotions, ointment, and dusting-powders containing boric acid are used to advantage in many acute inflammatory conditions of the mucous membranes and skin. As a stimulating and antiseptic mouth-wash there are few better than the official liquor antisepticus.

Probably the only objection to boric acid as a constituent of mouth-washes is its *slightly acid* reaction and rather sparing solubility in water. Whenever a stronger solution than the saturated is desired, the official glyceritum boroglycerini (glycerite of boroglycerin) can be used. This is *neutral* in reaction and can be employed in full strength or diluted. However, strong solutions should not be used continuously on account of the tendency to produce borism.

Incompatibilities.—In aqueous solution it will decompose carbonates and bicarbonates.

SODII BORAS—U. S. P.

Borax.—This salt has been fully discussed under Antacids (see p. 36). Its antiseptic and alkaline properties give it a prominent place among dental remedies. The physiologic action of borax closely resembles that of boric acid, for which it is often substituted to good advantage, especially in mouth-washes where it is desired to have an alkaline solution, and in tooth-powders and pastes. Boric acid, as well as all other acids, is incompatible with carbonates, and as calcium carbonate (chalk) is the base of nearly all dentifrices, boric acid should not be a constituent. Here the sodium salt, borax, can be employed with the same result without any reaction (incompatibility) between the ingredients of the mixture.

ACIDUM BENZOICUM—U. S. P.

(Benzoic Acid; $HC_7H_5O_2$.)

Benzoic acid is an organic acid obtained from benzoin and balsam of Peru, or prepared artificially from toluene, a coal-tar derivative. It occurs in white or slightly yellow scales or needle-shaped crystals of an aromatic odor and taste. It is sparingly soluble in water, but with an equal quantity of borax it can be dissolved to the extent of 1 per cent.; freely soluble in alcohol and glycerin. The dose is from 5 to 20 gr. (0.3–1.3 gm.).

Physiologic Action.—Benzoic acid has proven to be an antiseptic of considerable power. Long states that a solution of 1:400 has been found to destroy developed bacteria. It also acts as a stimulant to mucous membranes. Internally administered it increases, to a variable degree, the nitrogenous output and lessens the quantity of ethereal sulphates and indicin in the urine. In large doses benzoic acid and benzoates have an irritant action on the stomach, and in consequence excite nausea and vomiting (Stevens).

Therapeutics.— It is found that a saturated solution of borax (6 1/4 per cent.) will dissolve 1 per cent. of benzoic acid and still be alkaline. This is doubtless due to a reaction between the substances whereby sodium benzoate is formed, which is freely soluble. In this way it may be employed as a constituent of mouth-washes. It possesses no advantage over the sodium salt which had better be employed direct. Sodium benzoate is an excellent constituent of dentifrices. In the form of the benzoates it has been recommended in *rheumatism* or the *gouty diathesis*, but is not so efficacious as the salicylates. Balsam of Peru, which contains benzoic acid, is used externally as a parasiticide in *scabes* (itch).

Incompatibility.—Benzoic acid in the presence of moisture will react upon carbonates and bicarbonates. It should not be employed, therefore, as a constituent of dentifrices.

ACIDUM SALICYLICUM—U. S. P.

(Salicylic Acid; $HC_7H_5O_3$.)

Salicylic acid is an organic acid obtained from various plants, especially from gaultheria (wintergreen), but it is chiefly prepared artificially from phenol by acting upon the latter with caustic soda and carbon dioxid. It occurs as a white crystalline powder or in fine needle-shaped crystals, odorless, but possessing a sweetish, acrid taste. It is soluble in about 308 parts of water, 2 parts of alcohol, and 60 parts of glycerin. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action.—Salicylic acid, like many other drugs, acts differently upon different individuals and upon the same individual at different times. In susceptible subjects even small doses give rise to a peculiar feeling of fullness in the head, ringing in the ears, and, at times, it interferes with the senses of hearing and sight, causing deafness and dimness of vision. It enters the circulatory fluids as an alkaline salicylate, and is eliminated from the body in most of the

secretions, but principally in the urine. It is claimed on good authority that it increases the output of urea and uric acid.

Therapeutics.—This drug must be classed with our best antiseptics. Miller has shown that a 1 per cent. solution of salicylic acid will disinfect the mouth, as ordinarily considered, in one-quarter of a minute. It must not be forgotten, however, that the mouth cannot be disinfected in the true sense of the term. Its sparing solubility in water and its *acid* character render it practically useless as a constituent of mouth-washes, unless a salt, like borax, or alcohol be added to the solution. The chief use of salicylic acid and its compounds is in *acute rheumatism*, in which condition they are considered *specific remedies*. In some diseases, as certain kinds of *pyorrhea alveolaris*, which seem to be related to the rheumatic diathesis, salicylic compounds have proven to be efficacious. Dissolved in collodion, a dram (4.0 gm.) to the ounce (30.0 c.c.), it has long been used with success in removing *corns* and *warts*.

Incompatibilities.—Salicylic acid will react with carbonates, potassium chlorate, and potassium permanganate.

PHENYLIS SALICYLAS—U. S. P.

(Phenyl Salicylate; Salol; $C_6H_5C_7H_5O_3$.)

Salol is prepared by heating salicylic acid with phenol in the presence of phosphorus pentachlorid. It occurs as a white crystalline powder, of a faintly aromatic odor, and slightly sweetish taste, practically insoluble in water, soluble in alcohol, and freely so in ether, chloroform, and in fixed and volatile oils. The dose is from 5 to 15 gr. (0.3–1.0 gm.).

Physiologic Action.—Salol acts as an antiseptic like either of its constituents, salicylic acid and phenol. It is not a disinfectant, as it will not destroy bacteria, although it prevents their proliferation. It differs from salicylic acid in its action in that it is not irritating to the mucous membrane. Salol resists to a great extent the action of the gastric juice, passing through the stomach practically unchanged, but is gradually broken up in the intestine by the alkaline fluids into salicylic acid (60 parts) and phenol (40 parts).

Therapeutics.—On account of its insolubility in water, salol is not employed, to any extent, as a local antiseptic, except at times in alcoholic solution. We find its chief use as an intestinal antiseptic. Like other salicylic compounds, it is used in the various forms of *rheumatism*. It may be prescribed in powders or capsules in *diarrheas*

and other intestinal fermentations. Large doses must be avoided on account of the possible poisoning by phenol which is liberated.

In cases of *neuralgia* associated with rheumatism, the salicylates combined with some hypnotic drug is especially indicated. A powder composed of 5 gr. (0.3 gm.) of salol and 4 gr. (0.27 gm.) of phenacetin to the dose is a useful combination

ASPIRIN.

(Acetyl-salicylic Acid; $C_9H_8O_4$.)

Aspirin is the acetyl derivative of salicylic acid. It occurs in the form of small, colorless, crystalline needles, odorless, and having an acidulous taste; soluble in 100 parts of water, freely soluble in alcohol and ether. Boiling water decomposes the drug into acetic acid and salicylic acid or a salicylate. The dose is from 5–15 gr. (0.3–1.0 gm.) in capsules or wafers, and should be dispensed in wax paper, free from moisture.

Physiologic Action and Therapeutics.—Aspirin passes through the stomach unchanged, the decomposition being in the intestine. Its action is similar to that of salicylic acid, over which it possesses the advantage of producing less of the undesired local and systemic side effects, due to the slow liberation and assimilation of the salicylic acid. Small doses, however, produce in some subjects swellings about the head and face, and occasionally erythematous rash. It is especially useful in cases of *rheumatism* of a neuralgic character.

Incompatibles.—Heat, moisture, alkalies, their carbonates and bicarbonates. It keeps well when properly protected.

SALOPHEN.

(Acetyl-paramido-phenyl Salicylate.)

Salophen is an unofficial compound of salicylic acid. It occurs in white scales, tasteless and odorless, insoluble in water, but soluble in alcohol and ether. On account of the liability to poisoning from the phenol which is liberated in the intestine from salol, this compound was introduced. It contains about 50 per cent. of salicylic acid, and is decomposed by the alkaline fluids of the intestine into salicylic acid and a comparatively nonpoisonous compound, acetyl-paramido-phenyl. The dose is from 5–30 gr. (0.3–2.0 gm.).

Physiologic Action and Therapeutics.—The action of salophen is similar to other salicylic compounds. While it is not as efficacious in *rheumatism* as sodium salicylate, it being tasteless and unirritating to

the stomach can be given before meals in the milder manifestations of the disease. In cases of *neuralgia* of rheumatic origin associated with acute pain, salophen may be combined with such drugs as phenacetin and codein sulphate. A powder composed of 5 gr. (0.3 gm.) each of salophen and phenacetin and 1/4 gr. (0.016 gm.) codein sulphate is a valuable combination.

SODII SALICYLAS—U. S. P.

(Sodium Salicylate; $NaC_7H_6O_3$.)

Sodium salicylate occurs as a white amorphous powder, without odor, but of a sweetish, saline taste. It is freely soluble (0.8 parts) in water and in 6 parts in alcohol and in glycerin. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—The action of this salt is the same as that of salicylic acid. It has the advantage, however, of being more soluble and less irritating to the stomach. It is probably the most generally used of all the salicylic compounds, and is especially indicated in the *acute stage of rheumatism.* In cases of *pyorrhea* associated with rheumatism it may be given in 5 gr. (0.3 gm.) doses after meals, well diluted with water.

Sodium salicylate is discussed here more because of its relation to the previously considered drugs than because of its antiseptic properties, It is not considered a very efficient antiseptic.

VOLATILE OIL GROUP.

A true classification of this general group is not practicable. The volatile oils vary so markedly in their physical and chemic make-up that only those which possess antiseptic properties, and are employed in dental practice as such, will be considered here. As a class the volatile oils have enjoyed a wide range of usefulness as antiseptic remedies in the past. Some are useful remedies to be applied to carious cavities in vital teeth, where the pulp is involved, because of their penetrating and slightly analgesic properties. Those which are just sufficiently irritating to stimulate the pulp to healthy activity are the ones especially indicated for this purpose. These will be mentioned later. For years the volatile oils were employed in an effort to disinfect putrescent root-canals. In this they have proved to be a dismal failure. Here the noxious products of pulp decomposition are surrounded by hard tooth-structure and removed from live animal tissue,

therefore, we are justified in using true disinfectants—agents which will kill the germs and destroy their by-products. To use any of the essential oils for this purpose to-day, is but to adhere to the old empirical method of treatment.

OLEUM CAJUPUTI—U. S. P.

(Oil of Cajuput.)

Oil of cajuput is a thin, bluish-green, volatile oil distilled from the *fresh leaves* and *twigs* of *Melaleuca leucadendron*, a small tree growing in the East Indies. It has a camphoraceous odor and an aromatic, bitter taste. Its chief constituent is *cineol*, of which it should contain not less than 55 per cent. by volume.

Physiologic action and therapeutics resemble those of oil of cloves and oil of eucalyptus.

OLEUM CINNAMOMI—U. S. P.

(Oil of Cinnamon.)

Oil of cinnamon is a yellowish or brownish volatile oil distilled from the *bark* of the *shoots* of *cassia cinnamomum*, a tree which grows in China. The oil is sometimes commercially called oil of cassia. A species of cinnamon which grows in the Ceylon Islands produces a volatile oil having a finer flavor, though less employed. It has the characteristic odor of cinnamon and a spicy, burning taste. The chief constituent of oil of cinnamon is *cinnamic aldehyd*, also official, and of which it should contain not less than 75 per cent. by volume. There are two official preparations of oil of cinnamon; both are valuable in dental practice. *Aqua cinnamomi* (cinnamon water) used as a spray and as a vehicle for mouth-washes, and *spiritus cinnamomi* (spirit of cinnamon) used largely as a flavoring agent.

CINNALDEHYDUM—U. S. P.

(Cinnamic Aldehyd; C_9H_8O.)

Cinnamic aldehyd is a colorless liquid obtained from the oil of cinnamon or prepared synthetically. It has a cinnamon-like odor, and a burning, aromatic taste. Sparingly soluble in water, freely in alcohol, fixed and volatile oils. Pure synthetic cinnamic aldehyd has largely displaced the natural oil of cinnamon and may be used for nearly all purposes for which the latter is employed.

Physiologic Action.—Oil of cinnamon and cinnamic aldehyd are active antiseptics. Both are rather irritant to the pulp and pericemental membrane. Cinnamon is an agreeable aromatic stimulant, carminative, and stomachic. It is also claimed to possess feebly astringent properties. It enters into aromatic fluid extracts and also into many of the compound tinctures.

Therapeutics.—Oil of cinnamon has been employed in root-canal treatment, but because of its irritant properties and of its liability to stain the tooth-structure, it should be used cautiously, if at all. It is a constituent of Black's 1–2–3 mixture which contains oil of cinnamon 1 part, oil of wintergreen 2 parts, and phenol (carbolic acid) 3 parts. The most practical use that can be made of oil of cinnamon in dental practice, however, is as a flavoring agent. The official water may be employed as a vehicle for mouth-washes and sprays. Every dentist should know how to prepare the solution (see p. 8), as it should be freshly made and used freely in prophylactic and phyorrheal treatment.

OLEUM CARYOPHYLLI—U. S. P.

(Oil of Cloves.)

Oil of cloves is a thin, pale yellow, volatile oil distilled from *cloves*, the *dried flower buds* of *Eugenia aromatica*, a shrubby evergreen, introduced and cultivated in the East Indies. It has a strong aromatic odor of cloves and a pungent, spicy taste. Its chief constituent is *eugenol*, which is also official, and of which it should contain not less than 80 per cent. by volume.

EUGENOL—U. S. P.

(Eugenol; $C_{10}H_{12}O_2$.)

Eugenol is an aromatic phenol obtained from oil of cloves and other sources. It occurs as a thin, colorless or pale yellow liquid, highly refractive, and possessing a strongly aromatic odor of cloves and a pungent, spicy taste. It is practically insoluble in water, but freely soluble in alcohol. It may be used instead of oil of cloves, of which it is the chief constituent; it is also the chief constituent of oil of pimenta (allspice).

Physiologic Action.—Oil of cloves is just sufficiently irritant to the animal cell to be classed as an ideal antiseptic. It also possesses marked local analgesic properties. Internally administered, it is a powerful carminative and stimulant.

Therapeutics.—Because of its antiseptic and local analgesic properties, oil of cloves is one of the most valuable volatile oils. It has long been a popular remedy for odontalgia (toothache). Oil of cloves, or its chief constituent, eugenol, are excellent agents to be employed as the liquid for making pastes when pulp-capping is indicated. A paste made of precipitated calcium phosphate or pure zinc oxid, to either of which 2 per cent. of thymol has been incorporated, as the powder and oil of cloves or eugenol, as the liquid, is a valuable remedy for capping the pulp, or protecting this organ when it is involved from a deep-seated carious cavity. (See Practical Therapeutics, p. 137.) Applied to a canker sore or in cases of ulcerative stomatitis, oil of cloves will prove to be one of the best healing agents. It is a counter-irritant, and as such will stimulate morbid processes.

OLEUM EUCALYPTI—U. S. P.

(Oil of Eucalyptus.)

Oil of eucalyptus is a colorless, or faintly yellowish volatile oil distilled from the *fresh leaves* of *Eucalyptus globulus*, a tree which grows in the swampy regions of Australia and California. It has a characteristic, aromatic, somewhat camphoraceous odor and a pungent, spicy, and cooling taste. The chief constituent is *eucalyptol*, also official. .

EUCALYPTOL—U. S. P.

(Eucalyptol; $C_{10}H_{18}O$.)

Eucalyptol is a colorless liquid, obtained from oil of eucalyptus and several other volatile oils, especially oil of cajuput. It is an organic oxid, probably identical with *cineol*, the chief constituent of oil of cajuput. It has a characteristic and distinctly camphoraceous odor and a pungent, spicy, and cooling taste. Almost insoluble in water, freely soluble in alcohol.

Physiologic Action.—Locally applied, both oil of eucalyptus and eucalyptol are antiseptics, but have an irritant action. Commercial oil of eucalyptus is so irritating that it should not be employed in root-canal treatment. Many cases of pericementitis have been produced by commercial oil of eucalyptus having been sealed in the canals of teeth. Eucalyptol is also irritant, but not nearly so irritant as commercial oil of eucalyptus. When desired to be used in root-canal treatment,

eucalyptol should be employed, or a refined specimen of the oil which is practically all eucalyptol.

Therapeutics.—Both oil of eucalyptus and eucalyptol have been employed in root-canal treatment. Like all of the volatile oils, they are practically worthless as remedies for correcting putrescent pulp conditions where they have been largely employed in the past. While eucalyptol is not nearly as irritant as the oil of eucalyptus, it is still too irritant to be sealed in a canal as an antiseptic remedy after the removal of a live pulp. Agents, such as oil of cloves or eugenol, having local analgesic as well as antiseptic properties, are far preferable. Oil of cajuput, containing cineol, a compound identical with eucalyptol, has a solvent action on gutta-percha, as has also eucalyptol, hence these agents find their greatest use in dental practice as remedies for moistening root-canals previous to filling with gutta-percha. The author's formula for a remedy to be used for this purpose is: Menthol 2 gr. (0.14 gm.), thymol 3 gr. (0.2 gm.), eucalyptol 1 dr. (4.0 c.c.). This remedy is called *eucalyptol compound.*

Oil of Eucalyptus is an excellent remedy in chronic inflammation of mucous membranes, where it can be used as a spray combined with liquid petroleum in the proportion of 30–60 minims to the ounce (2–4 c.c. to 30.0 c.c.).

An infusion of eucalyptus leaves (5 per cent.) can be used as a mouth-wash or gargle in *stomatitis.*

As a stimulant expectorant eucalyptus is of great value in *colds* and *chronic bronchial catarrh.* A few drops of the oil of eucalyptus, or eucalyptol, can be dropped into hot water and the steam inhaled.

OLEUM MENTHÆ PIPERITÆ—U. S. P.
(Oil of Peppermint.)

Oil of peppermint is a colorless, or pale green volatile oil, distilled from the *fresh* or *partly dried leaves* and *flowering tops* of *Mentha piperita,* having the characteristic strong odor of the latter plant and a strong, aromatic, pungent taste, followed by a cool sensation upon inhalation. Its chief constituent is *menthol,* also official, and of which it should yield not less than 50 per cent. There are two official preparations of oil of peppermint, both of which are useful in dental practice.

Aquæ Menthæ Piperitæ, Peppermint Water, used as a spray, as a vehicle for mouth-washes and local anesthetic solutions. Spiritus Menthæ Piperitæ, Spirit of Peppermint, is used also as a flavoring agent.

MENTHOL—U. S. P.

(Menthol; $C_{10}H_{20}O$.)

Menthol is a stearoptene, or secondary alcohol, obtained from the oil of peppermint. It occurs in colorless, acicular, or prismatic crystals, having a strong and characteristic odor of peppermint, and a warm, aromatic taste, followed by a sensation of cold when air is inhaled. Sparingly soluble in water, freely in alcohol, ether, and chloroform. When triturated with about equal amounts of phenol, thymol, camphor, or chloral, it forms a liquid.

Physiologic Action.—Oil of peppermint and menthol are antiseptics, as well as possessing local analgesic properties to a marked degree. Like many other volatile oils of an aromatic character, oil of peppermint is a valuable carminative, stimulant, antifermentative, and antispasmodic.

Therapeutics.—Oil of peppermint, or menthol, is an ingredient of many remedies for obtunding sensitive dentin. A useful formula consists of menthol 20 gr. (1.33 gm.), chloroform 2 fl. dr. (8.0 c.c.), and ether 6 fl. dr. (24.0 c.c.). The official water is an excellent vehicle for local anesthetic solutions, as well as for mouth-washes and sprays. Menthol is a constituent of many dental liniments for *neuralgia* and *pericementitis.* A good liniment for this purpose contains menthol 20 gr. (1.33 gm.), chloroform 1 1/2 fl. dr. (6.0 c.c.), and tincture of aconite 6 fl. dr. (24.0 c.c.).

Oil of peppermint, or menthol, is a constituent of many lotions and sprays for the local treatment of diseases of the *mouth, ear, nose,* and *throat.* Menthol is used extensively in *headache*, being rubbed on the forehead or inhaled from a metal container. In cases of *itching* of the skin or mucous membrane, menthol is a valuable remedy because of its analgesic properties. For this purpose it should be dissolved in a bland oil, like liquid petroleum, in the proportion of 30 grains to the ounce (2.0 gm.–30.0 c.c.). It is also a constituent of *phenol compound* (see p. 51).

OLEUM THYMI—U. S. P.

(Oil of Thyme.)

Oil of thyme is a thin, colorless or pale yellow volatile oil, distilled from *Thymus vulgaris*, a common shrub (garden thyme) which is indigenous to France, but cultivated in the gardens of the United States. It has a strong odor of thyme, and a warm pungent and afterward cooling taste. Its chief constituent is *thymol*, which is official.

THYMOL—U. S. P.

(Thymol; $C_{10}H_{14}O$.)

Thymol is a phenol obtained from the oil of thyme. It occurs in large, colorless, translucent crystals, having a thyme-like odor and a pungent, aromatic taste, with a slight caustic effect upon the lips and mucous membranes. It is sparingly soluble (about 1100 parts) in water and in less than its own weight in alcohol, ether, and chloroform, also readily soluble in fixed and volatile oils. When triturated with about equal quantities of phenol, menthol, camphor, or chloral, it liquefies.

Physiologic Action.—Thymol is a powerful antiseptic. It might almost be classed as a true disinfectant. It resembles phenol in its action, but being slowly absorbed is far less poisonous, yet vastly superior to it as an antiseptic. It possesses a peculiar, but favorable action on animal tissue. It undoubtedly has a preservative action on dead animal tissue. It is a stimulant though not irritant or corrosive, and also has local analgesic properties.

Therapeutics.—Oil of thyme is not much used in dental practice except as a source from which thymol is obtained. Thymol has not been used to the extent which its importance merits, although it is rapidly gaining favor with modern therapeutists. It is a constituent of many remedies for root-canal treatment after live pulps have been removed. The author's *phenol compound* for this purpose contains menthol, 20 gr. (1.3 gm.), thymol, 40 gr. (2.6 gm.), and phenol (U. S. P.) 3 drams (12.0 c.c.). Dr. E. C. Kirk suggests using equal parts of thymol and phenol, called *thymophen*. Dr. H. Prinz uses thymol, camphor and phenol, called *thymocamphen*. A solution of a grain (0.06 gm.) to the ounce of water (30.0 c.c.), with a little alcohol used as a solvent, makes a good mouth-wash in the infectious forms of *stomatitis* and *pharyngitis* (Stevens). It is a constituent of the official mouth-wash, liquor antisepticus (see p. 40).

IODUM—U. S. P.

(Iodin; I.)

Iodin is a nonmetallic element obtained chiefly from the ashes of sea-weeds. It occurs in heavy, bluish-black, friable crystals, having a metallic luster, a distinctive odor, and a sharp, acrid taste. On heating, it emits a violet-colored vapor. Iodin is sparingly soluble in water (5,000 parts), freely in alcohol, ether, chloroform, and in a solution of potassium iodid.

The three official preparations are of value in dental practice. They are:

Liquor Iodi Compositus, U. S. P. Compound Solution of Iodin (Lugol's Solution; 5 per cent. of Iodin in a 10 per cent. solution of Potassium Iodid).
Tinctura Iodi, U. S. P., Tincture of Iodin, (7 per cent.).
Unguentum Iodi, U. S. P., Iodin Ointment, (4 per cent.).

IODOFORMUM—U. S. P.

(Iodoform; CHI_3.)

Iodoform is methyl tri-iodid, made by heating in a closed vessel iodin, alcohol, sodium hydrate, and water, wherein 3 atoms of hydrogen of the methane radicle (CH_4) is displaced by 3 of iodin. It occurs in small, lemon-yellow, hexagonal crystals, having a peculiar, very penetrating, and persistent odor, and an unpleasant, slightly sweetish, and iodin-like taste. It is very feebly soluble in water, soluble in about 47 parts of alcohol, and freely soluble in ether, chloroform, and oils. It contains about 96 per cent. of iodin. The official ointment of iodoform contains 10 per cent.

IODOLUM—U. S. P.

(Iodol; Tetra-iodo-pyrrol; C_4I_4NH.)

Iodol, or tetra-iodo-pyrrol, is a derivative of the base pyrrol (C_4H_5N), obtained by the direct action of iodin upon the base in the presence of alcohol. It occurs as a yellowish, crystalline powder, without odor or taste, and contains about 90 per cent. of iodin. Iodol is practically insoluble in water, but freely soluble in alcohol, ether, and oils. It is used as a substitute for iodoform, and, though more expensive, has the decided advantage in being odorless.

THYMOLIS IODIDUM—U. S. P.

(Thymol Iodid; Di-thymol-di-iodid; Aristol; $C_{20}H_{24}O_2I_2$.)

Thymol iodid or aristol, is obtained by acting upon thymol in aqueous solution of sodium hydrate with iodin dissolved in a solution of potassium iodid. It occurs as a brownish-red powder, tasteless and almost odorless, and contains about 45 per cent. of iodin. It is nearly insoluble in water, but freely soluble in ether, chloroform, and oils. It is used as a substitute for iodoform, but is rather un-

stable, being decomposed by heat, light, acids, alkalies, alcohol, and corrosive sublimate. It is more expensive than iodoform and less effective.

EUROPHEN (Not Official).

(Di-isobutyl-ortho-cresol-iodid; $C_{22}H_{29}O_2I$.)

Europhen is obtained in exactly the same manner as that of preparing aristol, except isobutyl-ortho-cresol is substituted for the thymol. It occurs as a very bulky, yellow, amorphous powder, of an aromatic odor, and contains 28 per cent. of iodin. It is insoluble in water and glycerin, but freely soluble in alcohol, ether, and oils. In dental practice it is an excellent substitute for iodoform, and is far more stable than aristol.

NOSOPHEN (Not Official).

(Tetra-iodo-phenol-phthalein; $(C_6H_2I_2OH)_2C_8H_4O_2$.)

Nosophen is obtained by the action of iodin on a solution of phenol-phthalein. It is a pale yellow powder, without odor and taste, and contains 60 per cent. of iodin. It differs from iodoform in being an active antiseptic and in not yielding its iodin to the tissues.

Physiologic Actions.—Iodin can be classed as an ideal antiseptic in that it is just sufficiently irritant to the animal cell to cause stimulation, giving to the latter new life and energy whereby the animal cells attacks and kills the invading germ, thus producing nature's method of disinfection.

When applied to the skin or mucous membrane it produces a yellowish-brown or black stain, and acts as an irritant or caustic, according to the strength of the solution used, and the frequency of the application. This discoloration can be readily removed by solutions of potassium cyanid, sodium hyposulphite or ammonia. When tincture of iodin is frequently applied, vesication is produced, or perhaps sloughing. The blood-vessels subjacent to the area to which it is applied are reflexly dilated, hence this drug is an efficient counter-irritant.

When internally administered, it is rapidly absorbed in the form of iodids and soon reappears in all the secretions of the body; the bulk being eliminated, however, in the urine, also in the form of iodids. The continuous use is followed by a group of symptoms known as *iodism.* The more common manifestations of this condition are associated with the mucous membrane of the respiratory tract and with the

skin, consisting of frontal headache, lacrimation, coryza, soreness of the throat, an increased flow of saliva, and sometimes an eruption on the skin. The amount of the drug required to produce iodism varies with different individuals. Iodoform differs somewhat in its action from iodin. Instead of being an irritant, it acts as a mild analgesic when applied to the mucous membrane and abraded surfaces, especially the latter. Iodoform, and allied compounds, have a favorable action on infected wounds, but how the result is produced is not understood. It is known that as dry powders they possess little or no bactericidal action, yet when applied to raw surfaces they retard germ-growth, probably through the free iodin liberated, as they nearly all liberate their contained iodin when in contact with the fluids of the tissues.

Therapeutics.—Applied to infected wounds, iodin is an efficient antiseptic. The tincture of iodin or the compound solution may be employed in full strength, or diluted, to *sluggish ulcers* and *abscess cavities*, or in cases of *local arsenical poisoning.* For the latter condition, a creamy paste made of europhen and liquid petroleum can be applied to the affected part on sterile gauze or cotton. Where pain is a prominent symptom, as in cases of lacerated *gum tissue* and *exposed process after extraction*, othoform (40 parts) can be mixed with europhen (60 parts) and made into a paste with liquid petroleum. Applied in the same manner it will stop the pain like magic. This paste is called *euroform.* As a counterirritant iodin is a valuable drug, as the blood-vessels subjacent to the area to which it is applied are reflexly dilated. The tincture of iodin in full strength should not be used as a dental counterirritant because of its local destructive action on the mucous membrane. For this purpose the compound solution should be employed or the tincture of iodin modified. A favorite combination is tincture of aconite 2 parts, tincture of iodin and chloroform, of each, 1 part. The chloroform volatilizes rapidly when applied and the irritant action of the iodin is modified by the aconite, a local sedative. This remedy is especially valuable in cases of pericementitis where a mild but persistent counterirritant effect is desired.

Iodin will stain the tooth-structure and there is no necessity for using the drug within the tooth, as other remedies are at hand which will accomplish all that can be expected of iodin without discoloration.

Iodin is useful as an antiseptic and stimulant in the treatment of *pyorrhea alveolaris* and will be referred to again in Practical Therapeutics (p. 347). Iodoform has little use in dental therapeutics except iodoform gauze, which is used in packing surgical wounds, abscess cavities, etc.

BETANAPHTHOL—U. S. P.

(Betanaphthol; $C_{10}H_7OH$.)

Betanaphthol is a monatomic phenol occurring in coal-tar, but usually prepared artifically from naphthalene. It occurs in white, shining crystalline scales, or as a yellowish-white crystalline powder, having a faint, phenol-like odor and a sharp, pungent, but not persistent taste. It is sparingly soluble in water, freely in alcohol, ether, and chloroform. It should be kept in dark amber-colored, well-stoppered bottles. The dose is from 2–10 gr. (0.13–0.6 gm.).

Physiologic Action.—Betanaphthol is antiseptic, antifermentative, deodorant, and may also be considered a disinfectant. Its action closely resembles that of phenol, but is less poisonous.

When applied locally to the skin or mucous membrane, betanaphthol is readily absorbed, and, in concentrated solutions, it is irritating to the tissues to which it is applied. Toxic symptoms may result from its absorption by the skin, which also resemble those of phenol.

Therapeutics.—Betanaphthol has been recommended as a constituent of root-canal filling materials. It will not corrode metal instruments, therefore solutions can be used for immersing instruments during the surgical treatment of *pyorrhea* and other operations. The solubility of the drug is increased in boiling water. A suitable solution can be prepared in hot water and used when sufficiently cooled. Some of the drug will be precipitated as the solution cools, but as it is not irritating in this strength solutions it does not matter materially. The saturated aqueous solution may also be employed to irrigate wounds and as a constituent of mouth-washes.

In medicine it is used as a parasiticide in certain diseases of the skin, as *scabies* (itch) and *ring-worm.* It is best to employ it in the form of an ointment in the strength of a dram (4.0 gm.) to the ounce (30.0 gm.), for in this way it is not irritating.

RESORCINOL—U. S. P.

(Resorcin; $C_6H_4(OH)_2$.)

Resorcin is a diatomic phenol occurring in the form of colorless or faintly reddish, needle-shaped crystals, or rhombic plates, having a faint peculiar odor and a sweetish, and afterward pungent taste. It is freely soluble in water, alcohol, ether, and glycerin. It darkens when exposed to light and air and should be kept in dark amber-colored, well-stoppered bottles. The dose is from 3–8 gr. (0.2–0.5 gm.).

Physiologic Action.—Resorcin acts very much like phenol,

but is less poisonous and less irritant. It has marked antiseptic properties, and being practically nonirritating is a useful drug in the treatment of many pathologic conditions about the mouth and throat.

Therapeutics.—Resorcin has been used for keeping instruments sterile during surgical operations, but its continued use will affect the metal. In a 2 to 5 per cent. solution it is efficacious as a mouth-wash or gargle in the treatment of certain subacute and chronic conditions of the mucous membrane, as in *ulcerative stomatitis*, *pharyngitis*, *laryngitis*, *whooping-cough*, and *diphtheria*. An ointment of resorcin (5 per cent.) is an excellent remedy to apply to *sloughing wounds*, *foul ulcers*, and *syphilitic ulcers*. A dusting powder, consisting of 1 part resorcin and 10 parts boric acid, can be used with much benefit in cases of *suppurating wounds*. As a remedy for dandruff of the scalp, Stevens recommends the following: Resorcin 1 1/2 dr. (6.0 gm.), castor oil ♏ xx–xxx (1.2 – 2.0 c.c.), bay-rum 3 1/2 fl. oz. (105.0 c.c.).

CARBO—CARBON.

Carbon is official in the following forms: *Animal charcoal*, *purified animal charcoal*, and *wood charcoal*. Animal charcoal, or bone-black, is prepared by burning bones in closed iron cylinders. It is composed of carbon and certain earthy salts (calcium carbonate and phosphate). Purified animal charcoal is bone-black from which the above-mentioned salts have been removed by hydrochloric acid. Wood charcoal is prepared by burning soft wood without access to air.

Charcoal is mentioned here because of its deodorizing power. It has the peculiar property of absorbing many times its own volume of gases and vapors. It is not used much in dental practice, except in the laboratory for refining metals. When well ignited it will deoxidize the most obdurate metals. Animal charcoal is largely used by chemists for decolorizing many solutions and for removing coloring matter from alkaloids. It is also employed as a filtering medium for purifying drinking-water. White wood ashes were formerly used for cleaning teeth by the laity. Because of the grittiness of the particles, it should not be so employed. It is sometimes internally given as an absorbent in *flatulent dyspepsia*. Here it is best administered in the form of lozenges.

CALENDULA—U. S. P.

(Marigold.)

Calendula is the *dried ligulate florets* of *Calendula officinalis*, an annual plant, indigenous to Southern Europe and Levant, fre-

quently cultivated as a garden ornament. It contains a bitter principle, *calendulin*, and a trace of volatile oil. The dose is from 5–30 gr. (0.3–2.0 gm.). The tincture is the only official preparation:

Tinctura calendulæ, U. S. P. (20 per cent.). *Dose*, 15–60 min. (1.0–4.0 c.c.).

Physiologic Action and Therapeutics.—Calendula has a stimulating action upon mucous membranes, and is used chiefly for its local influence. It acts similar to arnica, and is employed for practically the same conditions. The tincture may be applied to *recent wounds, lacerated gums, open sores, etc.* It hastens the healing of wounds, and materially aids union of coapted surfaces by *first intention*. It causes a *scar*, or *cicatrix*, to form without contraction of tissue, and is especially useful in *severe burns*.

ARNICA—U. S. P.

Arnica is the *dried flowers* of *Arnica montana*, a perennial plant, growing in temperate regions of Europe, Asia, and America. It contains a glucosid, *arnicin*, and a volatile oil. The dose is about 15 gr. (1.0 gm.). The tincture is the only official preparation:

Tinctura arnicæ, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).

Physiologic Action and Therapeutics.—The action of arnica closely resembles that of calendula. The tincture has been extensively used as a stimulating application in *sprains* and *bruises*. Its antiseptic power is doubtless due to its irritant effect upon animal cells, and to the alcohol which the tincture contains.

MYRRHA—U. S. P.

(Myrrh.)

Myrrh is a *gum-resin* obtained from *commiphora myrrha*, a small tree growing in Eastern Africa and Arabia. It occurs in the form of brownish-red, irregular-shaped tears, having an agreeable aromatic odor and a bitter acrid taste. The dose is about 5 gr. (0.3 gm.). Its official preparations and those into which it enters are:

Tinctura Myrrhæ, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).

Tinctura Aloes et Myrrhæ, U. S. P. (10 per cent. of each.). *Dose*, ½ to 2 fl. dr. (2.0–8.0 c.c.).

Mistura Ferri Composita, U. S. P. (Griffith's Mixture). *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Pilulæ Aloes et Myrrhæ, U. S. P. (Aloes, 2 gr.–0.13 gm.; Myrrh, 1 gr.–0.06 gm.). *Dose*, 1–4 pills.

Pilulæ Rhei Compositæ, U. S. P. (Aloes, ½ gr.–0.1 gm.; Rhubarb, 2 gr.–0.13 gm.; Myrrh, 1 gr.–0.06 gm.). *Dose*, 1–5 pills.

Physiologic Action and Therapeutics.—Myrrh is a stimulant to mucous membranes and acts as an antiseptic and astringent. The tincture, diluted with water, or with a weak solution of borax or potassium chlorate has been extensively used as a local application in *ptyalism*, *ulcerative stomatitis*, and *spongy gums*. Water added to the tincture causes a milky solution on account of the resinous constituent of myrrh.

OZONE AND OXYGEN.

(O_3 and O.)

Ozone is an allotropic form of oxygen, and may be prepared from the latter electrically. It occurs in the air, especially after an electrical storm. It is no doubt an important factor in the antiseptic processes of nature, and has been used to some extent as a therapeutic agent in the treatment of *pyorrhea alveolaris*, and other pathologic conditions; but its practical application, as yet, has not been fully demonstrated. **Oxygen** itself is used extensively in *nitrous oxid*, *ether* and *chloroform narcosis*, as well as in *bronchitis*, *anemia*, *phthisis*, and the later stages of *acute pneumonia*. It is given by inhalation by means of a specially devised apparatus.

PHENOL—U. S. P.

(Phenol; Carbolic Acid; C_6H_5OH.)

Phenol is obtained from coal-tar by fractional distillation. It is also prepared synthetically. When pure, it occurs in the form of colorless, needle-shaped crystals, of a characteristic odor and of an acrid, burning taste. On exposure to damp air it deliquesces, and the solution exposed to light gradually acquires a reddish tint. It is soluble in about 19.6 parts of water, and freely in alcohol, glycerin, ether, chloroform, and oils. It should be kept in dark amber-colored bottles, well-stoppered. Although it was official up to 1900 under the name Acidum Carbolicum, chemically considered, it is not an acid, but an alcohol of the benzene group. The dose is from 1/2–2 gr. (0.03–0.13 gm.).

All of the official preparations are valuable in dental practice. They are:

Phenol Liquefactum, U. S. P. (contains 86.4 per cent. of absolute Phenol and 13.6 per cent. of Water).
Unguentum Phenolis, U. S. P. Ointment of Phenol (3 per cent.).
Glyceritum Phenolis, U. S. P. Glycerite of Phenol (20 per cent.).

Physiologic Action.—Phenol is a disinfectant, as it destroys microorganisms. Some spore-bearing forms, however, are very resistant to its action. In weak solutions (2 per cent.) it acts as an antiseptic. Phenol is also a caustic and local analgesic. When applied to the skin or mucous membrane it blanches the surface and causes a burning sensation, which is soon followed by numbness. Later the part becomes red, then brown, and ultimately desquamation takes place. Its action is much more severe on mucous membranes, and should be used about the mouth with caution. Phenol coagulates albumin, therefore its caustic action is limited, and does not extend deeply into the tissues. Absorption of the drug occurs readily from the skin, mucous membranes, and wounds. Its prolonged use, even in dilute solutions (2–5 per cent.) may cause gangrene of the parts.

Poisoning by Phenol.—Poisoning by phenol may occur either from the drug being taken internally or from its external application. It is a poison used more widely for suicidal purposes, perhaps, than any other. Because of this fact, a law is in force in many States of the Union preventing its sale to the laity in stronger solutions than 33 1/3 per cent. The dilution being made with alcohol or glycerin.

Toxic doses render the patient rapidly unconscious, or the patient may drop dead in from twelve to fifteen minutes after taking from respiratory paralysis. Butler states that 8.5 gm. has caused the death of an adult in fifteen minutes. One and one-half grams has caused the death of a child in a short time. If the dose has not been sufficient to cause respiratory paralysis in so short a time, the symptoms are those of gastroenteritis—intense pain, violent vomiting of white slimy mucus, and purging. The pupils are contracted, stertorous breathing appears, with cold, clammy skin, pinched face, anxious expression, a rapid, feeble pulse, and finally followed by unconsciousness and death from failure of respiration. The characteristic phenomena are the odor on the breath, the destruction of the buccal mucous membrane, and the smoky urine. In poisoning from the external use of phenol the initial symptoms generally are headache, vertigo, pallor, muscular weakness, and discoloration of the urine.

Treatment of Poisoning.—When the poison has been taken by the mouth there are two drugs especially indicated in the treatment—alcohol and magnesium sulphate (Epsom salt). The alcohol neutralizes the caustic action, and the soluble sulphate forms with the phenol the

innocuous phenol sulphonate. Two or three ounces (60.0–90.0 c.c.) of diluted alcohol should be poured into the stomach through a tube, followed by frequent washing out of the stomach with warm water containing magnesium sulphate. Warm demulcent drinks are useful in allaying the irritation. To increase the efficiency of the function of the heart and respiration, strychnin sulphate and atropin sulphate are indicated. For the relief of pain, opium or its alkaloids may be administered. When phenol is accidentally or otherwise applied to the skin or mucous membrane, its caustic action can be prevented by immediately applying alcohol to the part.

Therapeutics.—Phenol, possessing as it does the properties of an antiseptic, disinfectant, cauterant, and local analgesic, is one of the most useful drugs in dental practice. As a disinfectant, the true value of the drug has been overestimated. Its great affinity for albumin, which it quickly and firmly coagulates, prevents any penetration beyond the superficial layer of tissue to which it is applied. At best, then, it is but a surface disinfectant. A 1 per cent. solution can be employed for immersing the points of instruments while scaling the teeth in *pyorrheal* treatment. Probably the only objection to this solution is the odor, and yet patients have been taught that any solution possessing the odor of phenol is cleansing, so even this objection loses its weight.

The drug can be added to local anesthetic solutions for the purpose of keeping the latter sterile. Two to 3 gr. (0.13–0.15 gm.) to the ounce (30.0 c.c.) is sufficient to prevent the growth of bacteria, and in this strength it can be injected into the tissue without any appreciable coagulation of the albumin.

Its local analgesic property makes it a valuable remedy for desensitizing dentin, to apply to an aching pulp in the early stages of *pulpitis*, and also as a root-canal dressing after the removal of the pulp tissue by either the anesthetization or devitalization method. It has been used for devitalizing the pulp tissue in deciduous teeth. Its action here is slow and unsatisfactory. As a stimulating agent for cauterizing *sinuses* associated with *dento-alveolar abscesses* it has long been used with success, where there is no root or bone complication. In cases of painful *canker sores* it is a most useful remedy. Applied full strength to the ulcerated or denuded spot, it arrests the septic process, and the coagulum formed serves as a protection to the exposed nerve-endings.

CRESOL—U. S. P.

(Cresol; Tricresol; $C_6H_4\left\langle\begin{matrix}CH_3\\OH\end{matrix}\right.$.)

Cresol, formerly commercially called *tricresol,* is a refined mixture of three isomeric cresols obtained from coal-tar, freed from phenol, hydrocarbons, and water. It occurs as a colorless or straw-colored refractive liquid, having a phenol-like odor and a burning, caustic taste. It is soluble in 60 parts of water, and miscible with alcohol and glycerin in all proportions. Cresol is sometimes erroneously called crecylic acid. It is not an acid, but is methyl phenol, the three isomeric forms being known chemically as ortho-, meta-, and para-cresol. On exposure to light, cresol turns to a yellowish-brown color. It should be kept in dark amber-colored bottles, well-stoppered. The dose is about 1 minim (0.06 c.c.). The official *liquor cresolis compositus* (compound solution of cresol) is practically identical with the commercial preparation known as *lysol.* It is a linseed-oil-soap solution of cresol, 50 per cent. in strength.

Lysol (unofficial) is a cresol preparation made by dissolving in fat, and subsequently saponifying with alcohol that portion of tar-oil which boils between 347° and 392° F. (190° and 200° C.). It contains 50 per cent. of comparatively pure cresols. It is a brown, oily liquid, and mixes with water to form a clear, saponaceous, frothy liquid.

Physiologic Action.— Cresol is one of the newer preparations, and its action is almost identical with that of phenol. Some authorities claim, however, that cresol is more toxic to bacteria than is phenol, but that it is less toxic to the animal cell than is the latter. In this respect it approaches what might be termed an *ideal disinfectant*—an agent which will kill the bacteria without acting deleteriously upon the animal cell, but cresol is too toxic to the animal cell to be so considered. Cresol is a caustic, though somewhat milder in action than phenol, and it possesses marked local analgesic properties.

Therapeutics.—Cresol is a disinfectant. It may be used in dental practice with equal results in almost every condition where phenol is indicated. In some instances it is greatly superior to the latter drug. Its odor may be considered an objection, but its valuable properties far outweigh this slight objection. As a local analgesic or anodyne for root-canal dressings it is valuable, and can be used with success as a cauterizing and stimulating agent in uncomplicated

sinuses associated with *dento-alveolar abscesses.* It can be dissolved in glycerin or alcohol, with both of which it is miscible in all proportions, and the solution added to mouth-washes, sprays, and other antiseptic remedies. A 1:500 solution may be used as a vehicle in which to dissolve local anesthetic agents, as cocain hydrochlorid. Such solutions remain free from bacteria, and are not irritant to the tissues in which they are injected. It is a constituent of the author's *formo-cresol* remedy which is an absolute *specific* for *putrescent pulp conditions.*

The compound solution of cresol and lysol is used in from 1 to 2 per cent. solutions in surgical work, as in the treatment of *pyorrhea.*

CREOSOTUM—U. S. P.

(Creosote.)

Creosote is a mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech. It is almost colorless, or a faintly yellow, oily liquid, having a penetrating, smoky odor, and a burning, caustic taste. It is soluble in 150 parts of water, in all proportions in alcohol, ether, chloroform, and oils. It seems rather difficult to obtain pure beech-wood creosote. Much of the creosote on the market is impure phenol (carbolic acid). Tests for the purity of the drug can be made as follows: 1. Mix equal quantities of the suspected specimen and collodion in a clean, dry test-tube, the formation of a coagulum will indicate the presence of phenol. 2. Mix intimately equal volumes of the suspected liquid and glycerin, then add one or more volumes of water, the absence of turbidity indicates an impure specimen of creosote. The dose is from 1–10 min. (0.06–0.6 c.c.). The one official preparation, aqua creosoti, is not much used in dentistry. As stated above, the chief constituents of creosote is guaiacol and creosol, the former is official.

GUAIACOL—U. S. P.

Guaiacol is a phenol derivative obtained by fractional distillation from creosote. It is a colorless, oily liquid, having a rather unpleasant aromatic odor and taste. It is sparingly soluble in water, freely so in alcohol and ether. The dose is from 1–3 min. (0.06–0.2 c.c.).

Physiologic Action.—Like all members of the phenol groups, creosote is an antiseptic, disinfectant, caustic and local analgesic. Its

action closely resembles that of phenol, but it is less irritant and toxic.

Therapeutics.—Creosote is employed in dental practice chiefly as a disinfectant and local analgesic. It is probably used more because of its analgesic property than any other. Three or four minims (0.18–0.24 c.c.) placed on a blank tablet, a piece of loaf sugar or candy is a valuable remedy for preventing *nausea in taking impressions.* This should be held in the mouth until the vehicle is dissolved. Creosote mixed with an equal volume of liquor formaldehyd, to which a small quantity of alcohol (20 min. to the ounce—1.3–30.0 c.c.) is added, makes an excellent remedy for the treatment of *putrescent pulp conditions.* Equal volumes of creosote and tincture of iodin has long been employed as a local analgesic and stimulant in *apical pericementitis.* Care must be taken to prevent the remedy from staining the dentin of the crown of the tooth, causing discoloration. Creosote is largely used as a *toothache* remedy by the laity. Guaiacol is not much used in dentistry, but is used in medicine in *pulmonary tuberculosis* as a substitute for creosote.

FORMALDEHYDUM—U. S. P.

(Formaldehyd; Formic Aldehyd; CH_2O.)

Formaldehyd is a colorless gas having a very pungent odor, obtained by the partial oxidation of methyl alcohol (wood-alcohol). The pharmacopeia recognizes a 37 per cent. aqueous solution of the gas under the name liquor formaldehydi—solution of formaldehyd. Various solutions of the gas are on the market, commercially called *formalin, formol, etc.* The gas in solution readily undergoes polymerization, whereby a solid form is obtained, known as *paraformaldehyd,* or *paraform* (CH_2O_3). This is a white crystalline powder, which yields formaldehyd on heating.

Physiologic Action.—Formaldehyd is one of the best disinfectants. Stevens states that a 1 per cent. solution of liquor formaldehyd kills pure cultures of pathogenic bacteria in an hour. It is a powerful deodorizer, readily uniting with hydrogen sulphid, mercaptan, ptomains, ammonia, and fetid ammonia bases to form inodorous compounds.

The gas is intensely irritating, when inhaled it causes severe hyperemia and even inflammation of the mucous membrane of the entire respiratory tract. Concentrated solutions will produce a slough almost as readily as arsenic trioxid.

The antidote for formaldehyd poisoning is ammonia, with which it forms the harmless hexamethylenamin (urotropin).

Therapeutics.—Because of the power formaldehyd has for uniting with the intermediate and end-products of *pulp decomposition*, forming with them nonpoisonous substances and converting the *gases* into *liquids* and *solids*, it is a most essential constituent of *putrescent pulp* remedies. Its irritating action can be controlled by mixing the official liquor formaldehyd with cresol, phenol, or creosote. The author's *formocresol* remedy is equal volumes of cresol and liquor formaldehyd. When used, this remedy should always be hermetically sealed within the tooth.

A 10 per cent. solution of liquor formaldehyd, to which 2 per cent. of borax or sodium carbonate is added, makes an excellent sterilizing fluid for small instruments. The alkaline salt (borax or sodium carbonate) prevents the formaldehyd from attacking the metal. In weak solutions (1:1000 to 1:500) it may be added to mouth-washes and sprays. Apparatuses are on the market for using paraform for sterilizing instruments. Probably the only objection to this method is the liability of the gas escaping in the office.

In medicine formaldehyd is extensively employed as a *surface disinfectant for rooms* containing the germs of contagious diseases. Both the aqueous solutions and the solid paraform are used for this purpose.

Incompatibilities.—Formaldehyd is incompatible with ammonia, alkalies, tannic acid, and mineral salts.

HEXAMETHYLENAMINA—U. S. P.

(Hexamethylenamin; Urotropin.)

Hexamethylenamin, or urotropin, is the product formed by the action of formaldehyd on ammonia. It is not used in dental practice, but mentioned here because of its formation within the tubular structure of the dentin when formaldehyd gas is sealed within a putrescent root canal.

AQUA HYDROGENII DIOXIDI—U. S. P.

(Solution of Hydrogen Dioxid; H_2O_2.)

Hydrogen dioxid is a very unstable compound, prepared by the action of mineral acids (usually sulphuric acid) on barium dioxid. The official aqueous solution should contain, when freshly prepared, about 3 per cent. by weight of absolute hydrogen dioxid, which corresponds to about 10 volumes of available oxygen. The solution is a colorless liquid, without odor, slightly acidulous to the taste, and pro-

ducing a peculiar sensation and a soapy froth in the mouth. It is liable to deteriorate with age or by exposure to heat or protracted agitation. The dose is from 1–4 fl. dr. (4.0–15.0 c.c.), well diluted with water.

There is an unofficial ethereal solution of hydrogen dioxid on the market which contains 25 per cent. of the drug.

Physiologic Action.—When hydrogen dioxid is applied to mucous membranes it decomposes into water and oxygen, the latter being given off in large quantities. The oxygen thus liberated is in the nascent state and readily oxidizes surrounding substances. Applied to suppurating wounds or abraded surfaces, effervescence follows from the free oxygen. This effervescence is not necessarily an indication of the presence of infection or pus, as hydrogen dioxid will produce effervescence when in contact with blood. Hydrogen dioxid, because of the liberation of nascent oxygen, destroys healthy granulations in healing wounds and should therefore be employed with caution, if used at all. It may cause sudden death when injected hypodermically or intravenously by the formation of gaseous emboli in a blood-vessel.

Therapeutics.—As a cleansing agent and disinfectant, hydrogen dioxid has been extensively applied to diseased surfaces, such as *canker sores* and other *ulcers*, *pyorrheal pockets*, *sinuses*, etc. In diluted solution it has been much used as an antiseptic remedy in many diseases of the *mouth*, *throat*, and *nose*. The drug may be used as a gargle or spray, or applied with a syringe or a swab. The value of hydrogen dioxid as a therapeutic agent depends upon the readiness with which it liberates oxygen when it is brought in contact with abraded tissues and with the fluids of the body. It should therefore be used with great caution in *all practically closed sinuses* and on *granulating surfaces*. While the drug has its use in dental practice, its real value has been overestimated, and much harm has resulted from its injudicious employment. It is used for moistening pumice in prophylactic work; the only objection to its employment here is that the agent causes effervescence and hides the field of operation. As a cleansing and whitening agent for the teeth, it is used by the laity, but its continued use as a mouth-wash is likely to affect deleteriously the tooth-structure, on account of the uncombined sulphuric acid it contains. This latter agent seems necessary to preserve the solution, and is added by manufacturers. As a bleaching agent it is of great value. The preparation mostly used for bleaching tooth-structure is the 25 per cent. ethereal solution.

POTASSII PERMANGANAS—U. S. P.

(Potassium Permanganate; $KMnO_4$.)

Potassium permanganate occurs in the form of slender, dark-purple prisms, odorless, and of a sweetish, astringent taste. It is soluble in 16 parts of water, and is decomposed by alcohol and hydrogen dioxid. It should be kept in glass-stoppered bottles, protected from light, and care should be taken not to bring it in contact with organic or readily oxidizable substances. The dose is from 1/2–2 gr. (0.03–0.12 gm.).

Physiologic Action.—In the presence of organic matter potassium permanganate quickly yields its oxygen; hence it is a good disinfectant and deodorant. Its usefulness, however, is limited, for when its oxygen is given up it is rendered inert.

Therapeutics.—Its readiness to part with oxygen renders it of great value as a deodorant, and in dilute solutions, 1–5 gr. (0.06–0.32 gm.) to 1 ounce (30.0 c.c.) of water, it is a useful remedy in *thrush*, *foul ulcers*, *putrid sore throat*, *syphilitic chancre*, and *cancer of the tongue*.

It is employed in surgical practice for disinfecting the hands, and should be followed with a saturated solution of oxalic acid to remove the stain. Its disadvantage for use in the mouth is its tendency to discolor the enamel of the teeth. This is only a surface and therefore temporary discoloration.

Incompatibilities.—Potassium permanganate is incompatible with organic substances, alcohol, and hydrogen dioxid.

CHINOSOL.

Chinosol occurs as a yellowish, crystalline powder, having a slight odor and a very disagreeable taste; soluble in water, but insoluble in alcohol and ether. It is used externally.

Physiologic Action and Therapeutics.—Chinosol is a chemic disinfectant. Cook and Mawhinney speak highly of the drug as a pus-destroyer, recommending its free use in from 1 to 10 per cent. solutions in *foul, chronic abscesses* and all other violent suppurations. The objections for using it in the mouth are: It corrodes steel instruments; discolors tooth structure; and has a very disagreeable taste. Cook recommends saccharin to overcome the taste.

KRESAMIN.

(Ethylenediamin Tricresol.)

Kresamin is a clear, colorless liquid, miscible in all proportions with glycerin, and soluble in 5 parts of water. It is only used externally.

Physiologic Action and Therapeutics.—Kresamin is a powerful disinfectant, with a claimed minimum toxicity. It is said that the bactericidal effect of the cresol and its power of penetrating animal tissue with less irritation are greatly enhanced by the presence of ethylenediamin. Mawhinney speaks of using it in cases of *apical pericementitis*, *chronic alveolar abscess*, and all inflammations accompanied with pus formation.

HYDRARGYRI CHLORIDUM CORROSIOUM—U. S. P.

While **mercuric chlorid** will be discussed with the class of alteratives under Mercury and its Compounds (see p. 187), the class of disinfectants would indeed be incomplete without the mention of this important and valuable drug.

Mercuric chlorid is the most popular of all the disinfectants for surgical work. The drug is cheap, soluble, and attacks bacteria and their by-products with energy. However, there are three principal objections to its employment: It is extremely poisonous; it attacks metallic instruments detrimentally; and it readily acts upon albuminous matter, rendering the drug inert. Stevens claims this last objection may be eliminated by adding to its solution a weak acid (tartaric or citric acid).

Heat is a valuable disinfectant, and without doubt is the most reliable for sterilizing instruments. All known pathogenic bacteria and their spores are destroyed by heat. The author's method of sterilizing operative and surgical instruments is to immerse them in boiling water for from 2 to 3 minutes, then dip them in a 10 per cent. formaldehyd solution to which borax has been added, after which they are again transferred to the boiling water and carefully dried (see p. 387).

ASTRINGENTS, STYPTICS, AND HEMOSTATICS.

Astringents are agents which produce contraction and condensation of tissue. **Styptics** and **hemostatics** apply to agents that arrest hemorrhage. When the agent is applied locally it is called a styptic; when administered internally it is called a hemostatic. Many of the

styptic and hemostatic agents control hemorrhage by virtue of their astringent property, for which reason these classes of remedies are discussed here conjointly. Astringent agents exert their influence most markedly when applied upon raw surfaces and mucous membranes. Many of them also have the property of diminishing or arresting glandular secretion. This result is produced more by the direct action of the agent upon the secreting cell than it is by the constriction of the blood-vessels of the part. Cook, in his experiments upon dogs, has shown that mouth-washes which contain astringent agents, notably zinc chlorid, arrest the secretion of ptyalin for a considerable number of hours after the solution is employed.

Most of the astringents are also irritants, especially is this true of some of the metallic salts, the action of which is more irritant and caustic than it is astringent. This is largely due to the liberation of an acid by the union of the metal with the albumin of the cells.

Astringents may be conveniently divided into two classes, *vegetable* and *mineral*. The efficacy of those of vegetable origin depends upon the tannic acid which they contain. It should be remembered that among the mineral astringents, bismuth subnitrate, zinc oxid, and lead acetate have more of a sedative than an irritant action. The vegetable astringents of importance are:

Tannic acid.
Gallic Acid.
Hematoxylin.
Ergot.
Krameria.
Hamamelis.
Hydrastis.

The important mineral astringents are:

Alum.
Lead Acetate.
Copper Sulphate.
Zinc Sulphate.
Zinc Phenolsulphonate.
Zinc Oxid.
Zinc Iodid.
Zinc Chlorid.
Calcium Chlorid.
Bismuth Subnitrate.
Silver Compounds.

ACIDUM TANNICUM—U. S. P.

(Tannic Acid; Tannin; $HC_{14}H_9O_9$.)

Tannic acid is the active constituent of all vegetable astringents. Its chief source is from *nutgall*. It occurs in the form of a light-yellowish, amorphous powder, odorless, and of a strongly astringent taste. Soluble in about 0.34 part of water and in 0.23 part of alcohol; also soluble in about 1 part of glycerin with the aid of moderate heat. The dose is from 3–10 gr. (0.2–0.6 gm.).

All of the official preparations are valuable astringent remedies. They are:

Collodium Stypticum, Styptic Collodion (20 per cent.).
Glyceritum Acidi Tannici, Glycerite of Tannic Acid (20 per cent.).
Unguentum Acidi Tannici, Ointment of Tannic Acid (20 per cent.).
Trochisci Acidi Tannici, Troches of Tannic Acid (1 gr.–0.06 gm. in each).

Physiologic Action.—Tannic acid, especially when applied to raw surfaces, coagulates the albumin of the superficial cells, causing condensation of the tissue, which is evidenced by the sensation of puckering. On mucous membranes it acts in a similar manner, combining with the proteids of the glandular cells, thus drying up the secretion. It also paralyzes the sensory nerve-endings and blunts the sense of taste. It may be considered a styptic, as it coagulates the albumin of the blood and checks hemorrhage. When administered internally, tannic acid is changed in the intestine into gallic acid, and in this form a certain amount is absorbed and eliminated in the urine, and acts as a hemostatic.

Therapeutics.—Tannic acid is a valuable astringent drug. It may be applied locally in the form of the glycerite in cases of *spongy gums*, or the glycerite may be added to mouth-washes to the extent of from 2 to 5 per cent., thus giving to the solution an astringent property. For years the glycerite was applied to the pulp tissue after devitalization for the purpose of toughening the tissue and aiding in its subsequent removal from the canals of teeth, but its liability to discolor the tooth-structure when so used constitutes a serious objection to its employment (see p. 287).

A solution of from 1/2 to 1 per cent. is a useful remedy to be used as a spray or gargle in cases of *stomatitis*, *laryngitis*, and *pharyngitis*. Many dentists are troubled with *hyperidrosis of the hands*. Lotions containing tannic acids are often beneficial in this condition. Dusting-powders, as well as lotions, are also used in *hyperidrosis of the feet*.

Styptic collodion serves as a protection to *lacerated* or *incised wounds*. Troches of tannic acid may be dissolved in the mouth with benefit in cases of *sore throat*.

Incompatibility.—Tannic acid is incompatible with alkaloids, gelatin, lime-water, the salts of iron, silver, lead, and copper. When potassium chlorate is triturated with tannic acid or organic drugs containing the latter, the mixture is liable to explode.

ACIDUM GALLICUM.

(Gallic Acid; $HC_7H_5O_5+H_2O$.)

Gallic acid is prepared generally from *tannic acid.* It occurs as white or pale fawn-colored, silky needles, odorless, having an astringent or slightly acidulous taste. It is soluble in about 85 parts of water, in 4 parts of alcohol, and in 12 parts of glycerin. The dose is from 5–20 gr. (0.3–1.3 gm.), given in powders or capsules.

Physiologic Action.—Gallic acid resembles tannic acid when administered internally; but, applied locally, it is a very feeble astringent, as it does not coagulate albumin and hence does not influence the tissue like tannic acid.

Therapeutics.—About the only indication for gallic acid in dental practice is in cases of *hemorrhage following extraction.* Here it would be employed purely as a hemostatic, and its action as such is questionable, except in *intestinal hemorrhage.*

KRAMERIA—U. S. P.

(Krameria; Rhatany.)

Krameria is the *dried root* of *krameria triandra,* a low shrub growing in the sandy localities in the mountains of Bolivia and Peru. Tannic acid is the chief constituent. The following official preparations are of value in dentistry:

Extractum Krameriæ. *Dose,* 5–10 gr. (0.3–0.6 gm.).
Fluidextractum Krameriæ. *Dose,* 5–30 min. (0.3–2.0 c.c.).
Syrupus Krameriæ. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Tinctura Krameriæ. *Dose,* ½–2 fl. dr. (2.0–8.0 c.c.).
Trochisci Krameriæ. *Dose,* 1–5 troches (each contains 1 gr.–0.06 gm. of the extract).

Physiologic Action.—The action of krameria is identical with that of its chief constituent, tannic acid.

Therapeutics.—The astringency of the drug is due entirely to the tannic acid which it contains in large amount. It has no special advantage over tannic acid. The various preparations of krameria, especially the tincture, may be added to mouth-washes and gargles to be used in cases of *rubber sore mouth, spongy gums, ptyalism,* and *pharyngitis.* The troches are also useful in *sore throat.*

HAMAMELIS.

(Witch-hazel.)

Hamamelis is official as the *bark* and *dried leaves* of *hamamelis virginiana,* a shrub growing in the damp woods of North America. It contains a volatile oil, a small amount of tannic acid, and a bitter principle. The official preparations are:

Aqua Hamamelidis, U. S. P. *Dose,* 1–4 fl. dr. (4.0–15.0 c.c.).
Fluidextractum Hamamelidis Foliorum, U. S. P. *Dose,* 1/2–1 fl. dr. (2.0–4.0 c.c.).

Physiologic Action.—The action of hamamelis is that of an astringent, due largely to the tannic acid it contains. Besides its astringent property, the drug is credited with having a marked sedative effect when topically applied.

Therapeutics.—Preparations of hamamelis are useful household remedies. As a topical application after *shaving,* and for *sprains* and *bruises* hamamelis water has long enjoyed a popular reputation. Diluted with water, alcohol, or glycerin (1 part to 3), the distilled extract may be used as a spray in *inflamed* and *spongy gums, pharyngitis,* and applied to the nasal mucous membrane after the removal of *polypi.*

Hamamelis water has been recommended to be diluted one-half with distilled water and used as a vehicle for local anesthetic solutions. It should not be so employed, as the tannic acid will act upon the alkaloidal salt (usually cocain hydrochlorid) and precipitate the alkaloid.

HÆMATOXYLON—U. S. P

(Logwood.)

Hematoxylon is the *heart-wood* of *Hæmatoxylon campechianum,* a rather small tree growing along the shores of the Gulf of Campeachy and in certain parts of South America. Besides tannic acid it contains a crystalline coloring principle, *hematoxylin.* There is only one official preparation:

Extractum hæmatoxyli, U. S. P. *Dose,* 5–30 gr. (0.3–2.0 gm.).

The drug has no dental use except as a staining agent for tissues in microscopic study, for which purpose it is extensively employed.

ERGOTA—U. S. P.

(Ergot; Ergot of Rye.)

Ergot is the sclerotium of *Claviceps purpurea,* a parasitic fungus, which replaces the *grain of rye, Secale cereale.* Ergot is obtained

chiefly from the rye growing in Russia, Spain, and Germany. The following preparations are official:

> Vinum Ergotæ, U. S. P. *Dose*, 1–4 fl. dr. (4.0–16.0 c.c.).
> Fluidextractum Ergotæ, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
> Extractum Ergotæ, U. S. P. *Dose*, 5–15 gr. (0.3–1.0 gm.).

Physiologic Action.—Ergot has no local action. The drug must be taken internally to produce its effects. When it enters the circulation it acts directly upon the muscular coats of the vessels, causing constriction of the arterioles, with an increase in arterial pressure. The involuntary muscles throughout the body appear to be influenced by ergot; the voluntary muscles are unaffected.

Therapeutics.—Ergot is used in dentistry for its hemostatic property. In cases of known *hemorrhagic diathesis* (*hemophilia*), it is well to administer the drug a few hours previous to the extraction of teeth or other operations involving hemorrhage. The fluid extract is the most reliable preparation and may be given in doses of 1/2–1 fl. dr. (2.0–4.0 c.c.).

Ergot should not be given when the hemorrhage proceeds from a large vessel, because here the muscular contraction could not close the vessel, and the increased arterial pressure, occasioned by the drug, would naturally increase the flow of blood.

The drug should not be given to *pregnant* women, because of the contraction it produces on the unstriped muscle of the uterus. Ergot is the one drug relied upon to prevent *postpartum hemorrhage* during and following labor in confinement cases.

HYDRASTIS—U. S. P.

(Golden Seal.)

Hydrastis is the *dried rhizome* and *roots* of *hydrastis canadensis*, a perennial herb growing in the woods of North America. One of the chief constituents is *hydrastin*, which is official under the title *Hydrastina*. Other constituents are *berberin* and *canadin*.

The official preparations of hydrastis are:

> Fluidextractum Hydrastis, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.)
> Tinctura Hydrastis, U. S. P. *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).
> Glyceritum Hydrastis, U. S. P. Externally.

Physiologic Action and Therapeutics.—The action of hydrastis is due almost entirely to the presence of the alkaloid, *hydrastin*, which it contains. Applied locally, it appears to have a stimulating influence

upon the *oral mucous membrane.* The glycerite may be added to mouth-washes (5 per cent.) and used in sluggish conditions of the mucous membranes, as in *chronic catarrh, etc.* The drug also has astringent and antiseptic properties. The fluid extract applied to *indolent ulcers* stimulates the condition to a healthy activity. Internally administered it acts as a stomachic and is a constituent of many bitter tonics.

Incompatibles.—These are the same as those of other alkaloids.

GLANDULÆ SUPRARENALES SICCÆ—U. S. P.

(Desiccated Suprarenal Glands; Suprarenal Extract.)

This product is neither a vegetable nor mineral astringent, but is considered here because it belongs to this group. It is the *glands* of the sheep or ox, freed from fat, cleaned, dried, and powdered; one part represents approximately 6 parts fat-free, fresh glands. It occurs as a light, yellowish-brown powder, partially soluble in water. The dose is about 4 gr. (0.25 gm.).

The active principle has been separated by different men and variously named *epinephrin* (Abel), *suprarenin* (Von Furth), *adrenalin* (Takamine and Aldrich). According to the best authorities, the last-named, adrenalin, represents more fully the active properties of the gland. It occurs as a white, crystalline substance. It dissolves with difficulty in cold water; but dissolves readily in acids, forming salts. Solutions of adrenalin chlorid are on the market under various names, as *adrenalin*, *adnephrin*, *suprarenalin*, etc.

Physiologic Action and Therapeutics.—Suprarenal gland, or solutions of its active principle, acts locally on a variety of structures, probably by stimulating the sympathetic nerve terminals. Its most important action is the constriction of blood-vessels, with the usual high rise of blood pressure. The drug is used in dentistry largely for its hemostatic properties. It should be remembered that the solutions of adrenalin will prevent hemorrhage if used before operating better than it will check the hemorrhage after it proceeds. Prinz and others recommend its use for the vasoconstrictor action to intensify and prolong the anesthetic effect of local anesthetics by retarding the circulation in the affected part and thus hindering the dilution of the anesthetic agent by too rapid absorption into the general blood stream. Solutions of adrenalin chlorid have been recommended as the vehicle for dissolving cocain hydrochlorid in the removal of the dental pulp

by pressure anesthesia. Its use here, however, is unwarranted and objectionable (see Practical Therapeutics, p. 283).

The dilute aqueous solutions are rather unstable, the deterioration being accompanied by a reddish or brownish discoloration. The drug can be obtained alone or combined with other drugs, in tablet form. The powder is stable.

GLANDULÆ THYROIDEÆ SICCÆ—U. S. P.

(Desiccated Thyroid Glands; Thyroid Extract.)

This product is the *glands* of the sheep freed from fat, cleaned, dried, and powdered. One part representing approximately 5 parts of the fresh gland. It is a yellowish, amorphous powder, partially soluble in water. Dose, about 4 gr. (0.25 gm.). The product is not much used in dentistry. Its general properties being alterative, hemostatic, and antifat.

ALUMEN—U. S. P.

(Alum; Aluminum and Potassium Sulphate; $Al_2K_2(SO_4)_4+12H_2O$.)

The **alum** recognized by the United States Pharmacopeia is aluminum and potassium sulphate. This is what is known in chemistry as a double sulphate. It occurs in large, colorless, octahedral crystals, odorless, but having a sweetish and strongly astringent taste. Soluble in water and in warm glycerin, insoluble in alcohol. The dose is from 5–15 gr. (0.3–1.0 gm.). As an emetic it may be given in much larger doses—1–2 dr. (4.0–8.0 gm.). The dried or burnt alum is also official under the title Alumen Exsiccatum, U. S. P.

Physiologic Action.—Alum is a powerful astringent when applied to the broken skin or mucous membranes. It acts by coagulating the albumin of the superficial cells, thus causing condensation of the tissues. With the blood it forms a firm coagulum, and tends to arrest hemorrhage. When applied to the unbroken skin, it has a tendency to thicken and harden it.

Therapeutics.—In edentulous mouths alum may be used to toughen the mucous membrane. A solution of from 5 to 10 gr. (0.3–0.6 gm.) to the ounce (30.0 c.c.) is a useful remedy in cases of *rubber sore mouth, subacute and chronic pharyngitis* and *laryngitis,* especially where there is a viscid mucous secretion. It has a destructive action on the tooth-structure, hence its prolonged use in the mouth is

contraindicated, except in edentulous mouths. It may be used as a styptic to arrest *hemorrhage from small wounds.* A large smooth crystal may be moistened and applied to the face after *shaving*, as the alum thickens and toughens the unbroken skin and also tends to arrest any *small hemorrhages* which may follow the operation. Dried alum may be employed as a mild caustic for *indolent ulcers* and for destroying *exuberant granulations*, as are often seen covering the fragment of a broken tooth-root a few days after an unsuccessful attempt in extraction.

Lotions of alum and dilute alcohol are sometimes employed in *hyperidrosis of the hands and feet.*

Incompatibles.—Alum is incompatible with alkalies, alkaline carbonates, lead acetate, mercury, iron salts, and tannic acid.

PLUMBI ACETAS—U. S. P.

(Lead Acetate; Sugar of Lead; $Pb(C_2H_3O_2)_2+3H_2O$.)

Lead acetate occurs in colorless, shining, transparent, heavy prismatic crystals or crystalline masses, having a faintly acetous odor and a sweetish, metallic taste. It is soluble in 2 parts of water and in 30 parts of alcohol. The dose is from 1–5 gr. (0.065–0.3 gm.).

Physiologic Action.—Metallic lead is practically inert, and the tissues take kindly to it. A clean lead bullet may become encysted in the tissues. Lead acetate has valuable therapeutic properties. Applied in solution to denuded or highly inflamed surfaces, its action is both astringent and sedative. In the mouth it acts immediately, coagulating the mucus and producing a sweet, styptic taste. When taken internally and absorbed, the lead enters as a constituent part into the protoplasm of the cells, and is exceedingly slow in being eliminated. *Lead poisoning* may result from the internal administration, but the cases fortunately are rare, for the acetate is an emetic and the emesis produced prevents toxic effects of the drug.

Therapeutics.—Lead acetate is not much employed in dental practice. Its sedative as well as its astringent properties make it a useful drug to be applied to *acute inflammatory conditions* of all mucous membranes. In cases of *inflammation* following the removal of foreign substances from the eye, a solution of lead acetate, 1–2 gr. (0.065–0.13 gm.), to the ounce (30.0 c.c.) of distilled water makes an excellent collyrium. Should the solution be turbid or milky, it indicates a trace of lead oxid. The smallest amount (1 min.) of dilute acetic acid will clear the solution.

CUPRI SULPHAS—U. S. P.

(Copper Sulphate; Blue Vitriol; $CuSo_4 + 5H_2O$.)

Copper sulphate occurs in large, transparent, deep-blue crystals, odorless, and of a nauseous metallic taste. It is soluble in about 2.5 parts of water, and almost insoluble in alcohol. The dose as an astringent is from 1/4–1 gr. (0.016–0.06 gm.); as an emetic, 5–20 gr. (0.3–1.3 gm.).

Physiologic Action.—The mode of action of copper sulphate depends largely upon the strength of the solution employed. Dilute solutions act upon mucous membranes and raw surfaces as an astringent. In concentrated solutions or applied in the crystal or powdered form, it acts as a mild caustic. Internally administered in large doses, it produces emesis by its direct irritant action on the stomach.

Therapeutics.—Copper sulphate is a useful drug in cases of *canker sores*, *ulcerative stomatitis*, and other *indolent ulcers*. Light applications of the solid crystal produces a stimulant effect upon the sluggish cells.

It is a prompt and powerful emetic, but considered too irritant to the stomach for ordinary use.

Bevan and Brophy report good results with copper sulphate in the treatment of *actinomycosis* occurring in man. They begin with about 1/4 gr. (0.016 gm.) given three times a day, gradually increasing the dose to 1 gr. (0.065 gm.). In addition to the internal administration of the drug, irrigations of a 1 per cent. solution are also employed.

CUPRI OXIDUM—Unofficial.

(Black Copper Oxid; CuO.)

Copper oxid occurs as a heavy dark-brown powder; insoluble in water. This product has been modified by Ames, and is used as the powder for the copper phosphate cement, a material extensively employed in filling cavities in children's teeth. This cement is claimed to possess marked antiseptic properties as well as serving the function of a temporary filling material.

ZINCI SULPHAS—U. S. P.

(Zinc Sulphate; White Vitriol; $ZnSO_4 + 7H_2O$.)

Zinc sulphate occurs in colorless, transparent crystals, or granular crystalline powder, odorless, and of an astringent metallic taste.

It is soluble in less than its own weight (0.53 part) in water, in about 3 parts glycerin, and insoluble in alcohol. It is rarely given internally except as an emetic, when the dose is from 10–30 gr. (0.6–2.0 gm.).

Physiologic Action.—Zinc sulphate acts as an astringent, styptic, emetic, and antiseptic. In weak solutions it is astringent and antiseptic; in strong solutions it acts as an irritant or caustic, tending to arrest slight hemorrhage when applied externally and, when administered internally, producing emesis.

Therapeutics.—Weak solutions of zinc sulphate may be applied to raw surfaces and to mucous membranes whenever a slight astringent effect is desired. A solution of from 1/2–2 gr. (0.06–0.1 gm.) to the ounce (30.0 c.c.) is a valuable collyrium in *simple conjunctivitis.* A 1 per cent. solution is also useful in *ulcerative stomatitis, cancrum oris,* and as a gargle in *enlarged tonsils* and *sore throat.*

As an emetic it is employed in *narcotic poisoning,* 10–30 gr. (0.6–2.0 gm.) dissolved in water, being given and repeated in fifteen to twenty minutes, if necessary.

Incompatibles.—Zinc sulphate is incompatible with alkalies, alkaline carbonates, vegetable astringents, lead acetate, silver nitrate, and lime-water.

ZINCI PHENOLSULPHONAS—U. S. P.

(Zinc Phenolsulphonate; Zinc Sulphocarbolate;
$Zn(C_6H_4(OH)SO_3)_2$.)

Zinc phenolsulphonate, also commonly, though erroneously, called zinc sulphocarbolate, occurs in colorless, transparent prisms, or tabular crystals, odorless, and having an astringent, metallic taste; on exposure to air and light it effloresces and may acquire a pink tint. It is freely soluble in water and alcohol. The aqueous solution is acid to litmus. It is rarely given internally; the average dose is 2 gr. (0.125 gm.).

Physiologic Action.—Zinc phenolsulphonate is an astringent and antiseptic, and produces a stimulant effect upon mucous membranes. It acts similar to other zinc salts, but the contained phenol radical adds to its antiseptic power.

Therapeutics.—This salt has but recently been employed in dental practice. Whitslar suggests the use of a 10 per cent. solution in cinnamon water as a stimulating antiseptic following the surgery of *pyorrhea alveolaris.* 1/2 dr. (2.0 gm.) added to 8 oz. (240.0 c.c.) of liquor antisepticus makes a valuable astringent mouth-wash to be used in *stomatitis* and *sore throat.*

ZINCI OXIDUM—U. S. P.

(Zinc Oxid; ZnO.)

Zinc oxid is a fine, white, amorphous powder, without odor or taste. Insoluble in water or alcohol. It is rarely used internally, an average dose being 4 gr. (0.25 gm.). There is one official preparation:

Unguentum Zinci Oxidi, U. S. P. (20 per cent.).

Physiologic Action.—Zinc oxid is a mild astringent and antiseptic.

Therapeutics.—This drug is used extensively as a vehicle for making pastes of liquids for treating *putrescent pulps* and *dento-alveolar abscess* and for *root-canal fillings.* It is the base of the powder for all zinc phosphate cements.

The ointment may be employed to soften and protect the mucous membrane of *dry* and *cracked lips* previous to operating or adjusting the rubber dam. The ointment is also extensively used as a slightly astringent and protective dressing for *cold-sores, burns, acute ulcers,* and *acute inflammatory skin diseases.*

ZINCI IODIDUM—U. S. P.

(Zinc Iodid; ZnI_2.)

Zinc iodid is a white, granular powder, without odor, and having a sharp, saline, and metallic taste. It is a very deliquescent salt and liable to absorb oxygen from the air, becoming brown from liberated iodin. Readily soluble in water, alcohol, or ether. It should be kept in glass-stoppered bottles. When used internally the dose is 1/2–1 gr. (0.03–0.06 gm.).

Physiologic Action.—Zinc iodid is astringent, antiseptic, and alterative.

Therapeutics.—This salt may be used as a mild astringent, antiseptic and alterative in cases of *ulcerative stomatitis* and *pyorrhea alveolaris.* Talbot suggests using the following remedy in cases of *flabby* and *inflamed gums:* Zinc iodid 15 parts, water 10 parts, iodin 25 parts, and glycerin 40 parts. The salt can also be added to mouth-washes to give astringency to the solution.

ZINCI CHLORIDUM—U. S. P.

(Zinc Chlorid; $ZnCl_2$.)

Zinc chlorid occurs as a white, granular powder, or fused mass, very deliquescent, odorless, and of a caustic metallic taste. Freely

soluble in water and alcohol. It is not used internally. The official preparation is:

Liquor Zinci Chloridi, U. S. P. (50 per cent.).

Physiologic Action.—Zinc chlorid is feebly astringent and antiseptic. It is the most caustic of all the zinc salts, and possesses marked styptic properties. Its prolonged use in the mouth interferes with the secretory action of the salivary glands (Cook).

Therapeutics.—Various strength solutions of zinc chlorid have enjoyed an unmerited reputation as a disinfectant in dental practice. For years the saturated solution has been mixed with zinc oxid to make a paste, so-called zinc oxychlorid cement, and used for filling root-canals. A 10 per cent. solution may be employed for *arresting profuse hemorrhage* in pressure anesthesia. Applied to *sensitive dentin* it acts as an obtundent. Care must be taken not to use it in deep-seated cavities nearly involving the pulp, as the hydrochloric acid liberated will irritate the pulpal organ. This irritant property may be controlled by dissolving the salt in alcohol and then adding chloroform. A formula for sensitive dentin follows: Zinc chlorid 20 gr. (1.3 gm.), alcohol and chloroform, of each, 1/2 fl. oz. (15.0 c.c.). The drug has been recommended to be added to mouth-washes to impart astringency to the solution. Its value here has been overestimated, for it is the least astringent of all zinc salts, and its continued use in the mouth changes temporarily the character of the saliva.

CALCII CHLORIDUM—U. S. P.

(Calcium Chlorid; $CaCl_2$.)

Calcium chlorid occurs in white, rather translucent, hard fragments, very deliquescent, odorless, and of an acrid saline taste. It is freely soluble in water, somewhat less so in alcohol. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—Internally administered calcium chlorid increases the coagulability of the blood. This property was first mentioned by Wright, of England, in 1893. It has been used with success in *hemophilia*, and in *small persistent hemorrhages*, like that which sometimes follows the extraction of teeth.

Wright found that the prolonged administration of the drug rather decreases than increases the coagulability of the blood, and that it acts best as a hemostatic by giving it in doses of from 3–10 gr. (0.2–0.6 gm.)

three times a day, for a period of two or three days, and discontinuing its use for a like period. The drug is very irritating to the stomach and should be given after meals, well diluted.

BISMUTHI SUBNITRAS—U. S. P.

(Bismuth Subnitrate; $BiONO_3+H_2O$(?).)

Bismuth subnitrate is a heavy white powder, of a somewhat varying chemic composition, odorless, almost tasteless, and permanent in the air. It is insoluble in water and alcohol, but soluble in glycerin in about 12 parts (Hereth). The dose is from 5–40 gr. (0.3–2.6 gm.).

Physiologic Action.—Upon the unbroken skin bismuth subnitrate simply acts as a protective agent; but upon raw surfaces and mucous membranes it also acts as an astringent and antiseptic. From denuded surfaces absorption of the drug takes place rather speedily, and poisoning has been known to occur from its too frequent application. The symptoms of *bismuth poisoning* are stomatitis, salivation, black discoloration of the mucous membrane of the mouth, and finally ulceration of the throat, diarrhea and albumin in the urine. Because of the protection the insoluble compound affords to the part, and also because it is just sufficiently astringent to act as a stimulant to the sluggish cells, this drug may be called an ideal antiseptic when applied to abraded surfaces.

Therapeutics.—Until recently bismuth subnitrate had not been employed in dentistry. In medicine it has long been a standard remedy in both *acute* and *chronic gastric catarrh* and *gastric ulcer*. Beck has recently proved its value in *chronic tubercular sinuses*. The drug is now extensively employed in *dento-alveolar sinuses*, *pyorrhea pockets*, and as a packing for *wounds* after surgical operations about the roots of teeth and alveolar process. The formula for Beck's paste is: Bismuth subnitrate 30 parts, white wax and paraffin, of each, 5 parts, and vaselin 60 parts. Mix with heat.

ARGENTUM—U. S. P.

(Silver; Ag.)

Metallic silver is used extensively in dental practice in the form of a wire for suturing fractured jaws, ligating loose teeth, etc. The most important salt of silver used in dentistry is silver nitrate, which is official.

ARGENTI NITRAS—U. S. P.

(Silver Nitrate; Lunar Caustic; $AgNO_3$.)

Silver nitrate occurs in colorless, transparent, tabular crystals, odorless, and of a caustic and rather metallic taste. It is soluble in about 0.6 part of water and in 26 parts of alcohol. The salt darkens on exposure to light, and should be kept in amber-colored bottles. The dose is from 1/6–1/2 gr. (0.01–0.03 gm.). The official preparations are:

Argenti Nitras Fusus, U. S. P. (Silver Nitrate molded into hard white cones or pencils).

Argenti Nitras Dilutus, U. S. P. (called Mitigated Caustic; pencils or moulded cones, containing about 33 per cent. of Silver Nitrate and the balance Potassium Nitrate).

Physiologic Action.—While silver nitrate, in dilute solution, acts as an astringent upon mucous membranes and raw surfaces in that it contracts the tissues to which it is applied by precipitating the albumin of the cells, in concentrated solutions or crystal form it acts as an unirritating caustic, coating and protecting the parts with white silver albuminate. Much investigation has been done by dentists in regard to the depth of penetration of silver nitrate, especially when applied to the tooth-structure. The prevailing opinion being that its penetration is limited on account of the impenetrable nature of the coagulum formed.

In weak solutions (1:2500), silver nitrate is active as a disinfectant. Internally administered in medicinal doses, its only action is that of an astringent and antiseptic.

The long-continued use of silver nitrate, even when locally applied, may result in a condition known as *argyria*. The manifestation of this condition is a characteristic, bluish-gray discoloration of the skin and mucous membranes. As a rule, it does not interfere with the general health and this discoloration is permanent.

Therapeutics.—Silver nitrate is a valuble therapeutic agent in dentistry, it being used largely for its caustic action. It is chiefly employed for its beneficent effect on *unnaturally exposed tooth-structure*, and on *inflamed mucous membranes* and *ulcerative surfaces*. To *exposed sensitive cementum* it may be applied in from 10 to 20 per cent. solution, the part first being dried; or the surface to be cauterized may be left moist and the solid stick used. Black calls attention to the fact that exposure to light aids the action of the salt.

This drug is one of the best caustics for destroying *exuberant* and *superfluous granulations*, for which purpose a solution may be used up to 50 per cent. in strength. In *chronic stomatitis* a 2 to 5 per cent. solution may be used with advantage; the pencils may be used in lightly touching *mucous patches*. Elliot recommends a 10 per cent. solution as a local application in the cracks which frequently occur about the hands and feet.

Precautions.—There is little danger of producing argyria from silver nitrate in dental practice, yet dentists should be familiar with this condition. In using the drug, care should be taken to prevent the cauterization of parts not intended, as the patient's lips, gums, tongue, buccal mucous membranes, etc. Sodium chlorid (common salt) is a positive antidote, as it forms with the drug the insoluble and inert silver chlorid. A solution of the antidote should always be in a convenient place when silver nitrate is used about the mouth.

Incompatibles.—With creosote it causes an explosion. It is also incompatible with organic matter, and many salts, as chlorids, bromids, iodids, sulphids, cyanids, carbonates, and phosphates.

OTHER SILVER SALTS AND SOLUBLE COMPOUNDS.

An effort has been made by manufacturing chemists to produce compounds of silver which possess the stimulant and disinfectant power of silver nitrate and which will not precipitate albumin or chlorids. Some of these preparations have proved exceedingly valuable.

Argyrol (Silver Vitellin).—This is a compound of a derived vegetable proteid and silver oxid, containing from 20 to 25 per cent. of silver. It occurs in black, glistening, hygroscopic scales, freely soluble in water and glycerin, insoluble in alcohol and oils.

Physiologic Action and Therapeutics.—In strong solutions (20–50 per cent.) argyrol is claimed to be nonirritating to mucous membranes. It, without doubt, possesses marked antiseptic properties. It is recommended in nearly all diseased conditions of the mucous membranes; as in *stomatitis*, *aphthous sore mouth*, *maxillary sinusitis*, *pharyngitis*, and *conjunctivitis*. Brophy recommends the drug in the after-treatment of antral operations. It is used in from 10 to 50 per cent. solutions. It will stain the skin and mucous membrane as well as the clothing. Care should be taken, therefore, in using the drug not to stain the latter. Hot water immediately applied will remove the stain from fabrics.

Protargol.—This is a proteid compound containing about 8 per cent. of silver. It occurs as a fawn-colored powder, freely soluble in water. It is claimed to be a good disinfectant, and comparatively free from irritant properties. Its action is similar to that of argyrol, and it is used for practically the same pathologic conditions. The extreme solubility of argyrol and the high percentage of silver which it contains has caused this drug to largely supersede protargol in dental practice.

BLEACHERS.

Bleachers, or **bleaching agents,** have been defined as agents used to restore the color of tooth-structure. The methods employed in bleaching teeth will be described in detail later in this work. It is only intended here to discuss the drugs used for this purpose. However, it is important that the student should know that the methods of bleaching teeth involve more or less chemistry. The general principle of bleaching teeth is to chemically change the insoluble colored pigment into a soluble compound so that it may be washed out of the tooth-structure, or else chemically attack the pigment in such a way as to break up its molecular arrangement and thus destroy its color. This may be accomplished by one of two general chemic processes—*oxidation* or *reduction.* The agents used for bleaching teeth, therefore, can be divided into two classes: Those which *oxidize* and those which *reduce* the pigment.

OXIDIZING AGENTS.

This class of drugs may also be conveniently subdivided into two classes—*direct* and *indirect* oxidizing agents. The former is any agent from which oxygen may be obtained directly, and the latter is any agent from which oxygen may be obtained indirectly.

The direct oxidizing agents used for bleaching teeth are:

Sodium Dioxid.	Acetozone.
Hydrogen Dioxid.*	Alphozone.
Oxalic Acid.	

There is only one indirect oxidizing agent used and that is:

Chlorin.

SODII DIOXIDUM—Unofficial.

(Sodium Peroxid; Na_2O_2.)

Sodium dioxid occurs as a light yellow, more or less granular powder. It is chemically soluble in water, and insoluble in absolute

alcohol and chloroform. It readily absorbs moisture from the air, thus deteriorating, and is best kept in tightly covered tin cans. The drug is never given internally.

Action.—To speak of the physiologic action of sodium dioxid would be incorrect, for it is such a violent caustic when applied to live tissue that its action cannot be confined within physiologic limits. It is, therefore, rarely used in medicine. As a direct oxidizing agent for bleaching teeth, where its action can be confined to the tooth-structure, it has no equal; especially is this true when the sodium dioxid is decomposed by water, which liberating *nascent oxygen* forms *sodium hydroxid* as a by-product. The nascent oxygen attacks the pigment which has stained the tooth, and the sodium hydroxid attacks any fatty substances which may be present, forming therewith a soluble soap. This double action of sodium dioxid, when decomposed by water, gives to the agent its great advantage as a bleaching agent. The drug may be decomposed by acids with the liberation of nascent oxygen, but by this means the valuable by-product (sodium hydroxid) is destroyed. Used in this way, then, sodium dioxid has no advantage over any other agent which liberates an equal volume of oxygen. It is a fact long recognized by those engaged in the bleaching of hair, feathers, wool, broom-corn, ivory, bone, etc., that the bleaching process is favored when carried on in an *alkaline* medium. This is likewise true in bleaching teeth.

Therapeutics.—In dental practice, where the violent caustic properties of sodium dioxid can be confined to the tooth-structure, this agent has a rather wide range of usefulness. Both the powder and *a solution* made by carefully adding the powder to cold water are used.

There are two important reactions which take place when sodium dioxid is added to water, and it is well to explain these here. If the powder is added to water in small quantities, care being taken to keep down the temperature with ice or cold water, a reaction takes place which results in a solution containing hydrogen dioxid and sodium hydroxid. This solution freshly prepared may be used for bleaching teeth. The hydrogen dioxid will liberate oxygen which does the bleaching and the sodium hydroxid creates an alkaline medium which favors the bleaching process; it also acts to advantage upon any fats which may be present. The great difficulty here is in obtaining the solution fresh, as the sodium hydroxid gradually decomposes the hydrogen dioxid into water and oxygen, the latter gas being lost. If sodium dioxid is added to water without any precaution to lowering

the temperature, a somewhat different reaction takes place. Here the drug is at once decomposed into oxygen and sodium hydroxid. For all dental purposes this is the best way to use the drug, viz.: Place the powder into the cavity or canal of the tooth and decompose it into oxygen and sodium hydroxid by adding distilled water. In this way it may be used for *bleaching teeth, disorganizing remnants of pulp tissue,* and *enlarging tortuous root-canals.* For the latter purposes the use of the drug should alternate with a 50 per cent. solution of sulphuric acid.

Incompatibles.—Sodium dioxid will produce a pyrotechnic display with many of the volatile oils and with phenol. It is decomposed by water and acids.

Hydrogen Dioxid.

This direct oxidizing agent has been fully discussed under the heading of Disinfectants. The official 3 per cent. solution is sometimes concentrated or used with other drugs for bleaching purposes. As a bleacher this solution has largely been superseded by the commercial preparation called "caustic pyrozone," which is a 25 per cent. ethereal solution of pure hydrogen dioxid. Like all direct oxidizers, its value depends upon the nascent oxygen which it liberates. For *bleaching teeth* better results are produced when the tooth-structure has been previously moistened with a weak alkaline solution, such as lime-water.

ACETOZONE—Unofficial.

(Benzoylacetyl Dioxid; $C_6H_5COO.O.COCH_3. = C_9H_8O_4$.)

Acetozone, or **benzoylacetyl dioxid,** is made by the oxidation of a mixture of benzaldehyd and acetic anhydrid. It occurs as a white, shining crystalline powder. Slightly soluble in water, alcohol, and fairly so in ether and chloroform. In oils it is soluble to the extent of about 3 per cent. All solvents slowly decompose the drug with the exception of neutral petroleum oils. Not used internally in dentistry.

Action and Uses.—Acetozone belongs to a class of compounds known as the *organic dioxids or peroxids* in which an excess of oxygen has been combined in such a way that it is slowly given off in the nascent state. In the presence of water it hydrolyzes, forming benzoperacid and aceto-peracid which exert marked oxidizing and disinfectant action. Acetozone is used in dentistry as a bleaching agent. Hoff recommends placing the powder in *the cavity of the tooth to be bleached,* moisten with water to bring about the hydrolysis, and hermetically seal.

ALPHOZONE—Unofficial.

(Succinic Dioxid; $(COOH.CH_2.CH_2.CO)_2O_2 = C_8H_{10}O_8$.)

Alphozone, or succinic dioxid, is an organic dioxid, or peroxid, resulting from the condensation of hydrogen dioxid with succinic anhydrid. It occurs as a fluffy, white, crystalline powder. Soluble in 30 parts of water at ordinary temperature; moderately soluble in alcohol, sparingly so in ether, and insoluble in chloroform. It should be kept in a dark place and in tightly stoppered bottles. Not used internally in dentistry.

Action and Uses.—Alphozone is a powerful oxidizer, and thus becomes an antiseptic, disinfectant, and deodorant. It possesses marked bleaching properties. It is claimed to possess an advantage over hydrogen dioxid as a therapeutic agent in that it does not effervesce with pus nor in contact with living tissues. Alphozone may be used for *bleaching teeth* in the same manner as acetozone. Water does not decompose the drug. It may also be employed for *disinfecting the hands* and such instruments as are not attacked by oxidizing agents. The drug can be obtained in the powder form or in tablets containing one grain (0.065 gm.) each, which is used for making solutions for external use. One tablet to 2 fl. oz. (60.0 c.c.) makes a suitable disinfectant solution for general use.

ACIDUM OXALICUM—Unofficial.

(Oxalic Acid; $H_2C_2O_4 + H_2O$.)

Oxalic acid occurs in the form of transparent, prismatic crystals, odorless, and of a very acid taste. It is readily soluble in water and alcohol. Not used internally in dentistry.

Action and Uses.—Oxalic acid is a direct oxidizer. As a bleaching agent for teeth its power is limited. Kelley and others have recommended it as a *disinfectant for the hands.*

CHLORUM—Unofficial.

(Chlorin; Cl.)

Chlorin is a heavy, yellowish-green gas, of a very suffocating odor and a caustic taste. It may be prepared by acting upon chlorinated lime with an acid. The gas is soluble in water. One official preparation:

Liquor Chlori Compositus, U. S. P. (contains about 0.4 per cent. of the gas.)

Action and Uses.—Chlorin is a powerful irritant. When inhaled it causes inflammation, and, at times, edema of the lungs. It has such a great affinity for hydrogen that it will abstract this element from a molecule of water, liberating the oxygen in the nascent state. Because of this fact it is an indirect oxidizing agent, and its bleaching ability as well as its disinfectant power depends upon this property. About the the only use made of chlorin in dental practice is as a bleaching agent. It bleaches indirectly. For *bleaching teeth,* compounds and preparations of chlorin, from which the gas is liberated, are used.

CALX CHLORINATA—U. S. P.

(Chlorinated Lime; $CaOCl + CaCl_2$.)

Chlorinated lime is a mixture of calcium hypochlorite and calcium chlorid. It is prepared by acting upon slacked lime with chlorin gas, and should contain not less than 30 per cent. of chlorin. It occurs as a grayish-white powder, having a strong odor of chlorin and a disagreeable saline taste. It is partially soluble in water and alcohol.

Action and Uses.—As the mixture constantly liberates chlorin gas, it is a disinfectant and bleacher. It is used in dentistry as a means of obtaining chlorin for *bleaching teeth.*

LIQUOR SODÆ CHLORINATÆ—U. S. P.

(Solution of Chlorinated Soda; Labarraque's Solution.)

This is a solution of several chlorin compounds of sodium containing at least 2.4 per cent. by weight of available chlorin.

Action and Uses.—Solution of chlorinated soda is a disinfectant, deodorant and bleacher. Like chlorinated lime, it is used in dentistry as a means of obtaining chlorin for *bleaching teeth.* The solution should be freshly prepared.

REDUCING AGENTS.

These are agents which have the power of abstracting oxygen from a compound containing it. The process is called *reduction* or *deoxidation.*

There is only one reducing agent used for bleaching teeth. That is sulphurous acid.

ACIDUM SULPHUROSUM—U. S. P.

(Sulphurous Acid; H_2SO_3.)

The official solution of **sulphurous acid** is a 6 per cent. aqueous solution of sulphur dioxid.

Action and Uses.—Sulphur dioxid is a gas which chemically dissolves in water and forms sulphurous acid. This acid has a great affinity for oxygen, and absorbs the latter gas from the air or abstracts it from compounds containing it, thus reducing the compound and forming sulphuric acid.

For *bleaching teeth* it is best to use a mixture of such compounds as when dissolved will react upon each other and produce sulphur dioxid within the tooth to be bleached. The gas unites with the water present forming sulphurous acid which has a tendency to abstract oxygen from the colored pigment which has stained the tooth, and thus the rearrangement of the elements of the colored molecule destroys its color. Kirk suggests using a mixture of 10 parts of sodium sulphite and 7 parts of boric acid. This mixture may be packed into the cavity of the tooth, moistened with water, and hermetically sealed. The tooth should subsequently be washed with an alkaline solution to neutralize the acid formed.

ESCHAROTICS OR CAUSTICS.

Escharotics or caustics are agents which destroy the tissue upon which they act. While the action of this class of drugs varies with the drug employed, it may be stated in general that their action is purely chemic or physico-chemic. Many of them have an immediate chemic action upon the tissues, and are sometimes called *corrosives*. Nearly all escharotics produce an eschar, the character of which depends largely upon the tissue involved. This eschar is ultimately separated from the living tissues by the inflammatory process thus inaugurated. Some of the agents belonging to this class are quite readily absorbed, and may cause systemic poisoning. The compounds of arsenic—especially arsenic trioxid, long used in dentistry for devitalizing the pulps of teeth—are of this character, as they have a specific poisonous action upon the cells. The salts of chromium and osmium may also be mentioned in this connection. The strong mineral acids abstract water from the tissues and precipitate the proteids; the alkaline hydrates, on the other hand, not only abstract water but dissolve the proteids and form with them soluble compounds.

The chief escharotics are:

Mineral Acids:	Arsenic Trioxid.
Sulphuric Acid.	Chromium Trioxid.
Nitric Acid.	Osmic Acid.
Hydrochloric Acid.	Potassium Hydroxid.
Phenol.*	Sodium Hydroxid.
Acetic Acid.	Zinc Chlorid.*
Trichloracetic Acid.	Mercuric Chlorid.*
Monochloracetic Acid.	Silver Nitrate.*
Lactic Acid	Actual Cautery.

Several of the above escharotics have been considered elsewhere. Those which have not will here be discussed in detail.

ACIDUM SULPHURICUM—U. S. P.

(Sulphuric Acid; Oil of Vitriol; H_2SO_4.)

Sulphuric acid is a colorless, heavy, oily liquid, without odor, and of an extremely sour taste and acid reaction. It is miscible with water and alcohol in all proportions with the evolution of heat. A precaution to be remembered is that in diluting the acid should be added to the water or other diluent, and not the reverse. The acid is not used internally in dentistry. The official preparations are:

Acidum Sulphuricum Dilutum, U. S. P. (Contains 10 per cent. of absolute Sulphuric Acid.)

Acidum Sulphuricum Aromaticum, U. S. P. (Contains about 10 per cent. of Sulphuric Acid in Alcohol with the addition of such aromatics as Ginger and Cinnamon.)

Phenolsulphonic acid ($C_6H_4(HSO_3)OH$) is prepared from phenol and chemically pure sulphuric acid. It occurs as a faint reddish-colored, heavy, syrupy liquid, of a rather phenol-like odor and a characteristic acid taste and reaction. It unites with some bases to form salts, notably zinc. It is rather difficult to combine phenol and sulphuric acid so that the resultant mixture may be diluted with water without separation of the original constituents. Inasmuch as the concentrated phenolsulphonic acid is rarely used in dentistry, directions here follow for preparing it so that any dilution may be made: Ninety-seven parts by weight of pure concentrated sulphuric acid are gradually added to 93 parts by weight of pure phenol and the mixture kept at a temperature of about 100° C. for about twenty hours, until only a small percentage of sulphuric acid remains uncombined. When the reaction is thus complete, sufficient distilled water is added to make the finished product assay about 80 per cent. phenolsulphonic acid. This liquid is miscible with water in all proportions; and when-

ever phenolsulphonic acid is mentioned in these pages, this product is meant. It should not be confused with the preparation suggested by Cook, of Chicago, which is a heavy, oily, dark brown liquid made by mixing crude sulphuric acid and crude phenol, and which can only be used in full strength, as water causes a separation of the constituents.

Physiologic Action.—When applied to the skin, accidentally or otherwise, sulphuric acid in concentrated form causes an intense, burning pain, and results in a rapid destruction of tissue. The eschar is at first white, gradually becoming brown. The corrosive effect upon mucous membranes is still more marked than upon the skin. The acid rapidly extracts water from the tissue, the alkalies are neutralized, and the proteids precipitated, this results in the complete destruction of the tissue (dissolution). When taken internally large doses cause burning in the throat and esophagus, violent pain in the abdomen, constant vomiting of dark matter, mixed with blood and mucus, difficult breathing, and ultimate collapse.

Therapeutics.—Sulphuric acid is used in dentistry more than any of the other mineral acids. Because of its violent action upon soft tissue, it is seldom used as an escharotic except at times on pulp tissue where its action can be controlled. By some it is used in 50 per cent. solution to neutralize the contents of *putrescent root-canals*, and for enlarging *fine and tortuous canals*. This is known as the Callahan method. It may also be employed to destroy a *remnant of a pulp* in the apical end of a root, and for *dislodging pulp nodules* in the pulp-chambers and root-canals of teeth. A 10 per cent. solution may be cautiously used for sterilizing the dentin and opening the tubules previous to removing a pulp by pressure anesthesia or bleaching the tooth-structure. Care must always be exercised in the use of sulphuric acid, even in weak solutions, not to get the agent on the enamel of the crown of the tooth or soft tissues of the mouth. It should be remembered here that a weak solution of an alkaline salt, such as sodium bicarbonate, will at once neutralize the action of all mineral acids, and such a solution should be ready to use when these agents are employed. Perhaps the most useful combination of sulphuric acid in dental practice is *phenolsulphonic acid*. This agent may be used in nearly every instance where sulphuric acid is indicated and often to advantage. In *caries* or *necrosis of bone*, in *chronic alveolar abscess*, and *pyorrhea alveolaris*, where the "acid treatment" is indicated, phenolsulphonic acid, properly employed, will give beneficial results.

Incompatibles.—Sulphuric acid is incompatible with alkalies,

alkaline carbonates, iodids, and certain salts of lead. It is explosive with oil of turpentine and sugar, and carbonizes syrups because of the sugar therein contained.

ACIDUM NITRICUM—U. S. P.

(Nitric Acid; Aqua Fortis; HNO_3.)

Nitric acid is a strongly corrosive, fuming, caustic liquid, composed of 68 per cent. absolute nitric acid and 32 per cent. of water with which liquid it is miscible in all proportions. It reacts explosively with alcohol and glycerin, and is not used internally in dentistry. The official preparations are:

Acidum Nitricum Dilutum, U. S. P. (10 per cent.).
Acidum Nitrohydrochloricum, U. S. P. (Aqua Regia; Nitric Acid 18 vols.; Hydrochloric Acid 82 vols.).
Acidum Nitrohydrochloricum Dilutum, U. S. P. (approximately 10 per cent. absolute Acid).

Physiologic Action and Therapeutics.—Nitric acid, though a powerful escharotic, is not as penetrating or painful as sulphuric acid. It produces a characteristic yellow stain on the skin and mucous membrane. In large doses it causes practically the same train of symptoms as sulphuric acid, except the yellow instead of the white and then brown discoloration. The acid is not used to any extent in dental practice. It may be applied to *warts* and other *fungous growths*, and has proved to be a reliable agent in *phagedenic ulcers*, *chancroids* and *chancres*.

Incompatibles.—This acid is incompatible with alkalies, alkaline carbonates, oxids, lead acetate, and iron sulphate. It explodes with such agents as alcohol, glycerin, phenol, and volatile oils.

ACIDUM HYDROCHLORICUM—U. S. P.

(Hydrochloric Acid; Muriatic Acid; HCl.)

Hydrochloric acid is a fuming, corrosive liquid, consisting of 31.9 per cent. of absolute hydrochloric acid. It is miscible with water and alcohol in all proportions. It is not used internally in dentistry. The official preparation is:

Acidum Hydrochloricum Dilutum, U .S. P. (10 per cent. by weight.)

Physiologic Action and Therapeutics.—The action of hydrochloric acid closely resembles that of the other mineral acids. As a therapeutic agent the strong acid is not used to any extent in dentistry. It is chiefly used to prepare the diluted and other acids. Dilute

hydrochloric acid has been used by Andrew and Morris for the *removal of sequestra,* and necrosed bone in *osteitis* and *caries.* It is inferior to phenolsulphonic acid for these purposes.

Incompatibles.—The acid is incompatible with alkalies, carbonates, and silver nitrate.

Treatment of Poisoning by Mineral Acids.—The treatment of poisoning by the mineral acids to be effective should be prompt. The cautious administration of alkalies is indicated to chemically neutralize the acid. Lime-water, magnesia, and soap are best. Carbonates must be used with care, if at all, on account of the liability to rupture the stomach from the evolution of carbon dioxid (a gas). Stevens cautions against the use of the stomach-pump on account of the risk of piercing the softened esophagus. After the acid is neutralized with the alkaline solutions, demulcent drinks, such as albumin-water, milk and raw eggs, should be given to soothe the parts. To control the pain, opium, or its alkaloids, are indicated, and whisky or brandy should be injected subcutaneously in case of collapse.

ACIDUM ACETICUM—U. S. P.

(Acetic Acid; $HC_2H_3O_2$.)

Acetic acid is a liquid composed of 36 per cent. by weight of absolute acetic acid and 64 per cent. of water. It occurs as a clear, colorless liquid, having a strong, vinegar-like odor, and a purely acid taste. Miscible with water and alcohol in all proportions. The dose of the diluted acid is 1–2 fl. dr. (4–8 c.c.). The official preparations are:

Acidum Aceticum Dilutum, U. S. P. (6 per cent. by weight of absolute Acetic Acid).
Acidum Aceticum Glaciale, U. S. P. (Glacial Acetic Acid; 99 per cent. absolute Acid).

Physiologic Action.—The concentrated acetic acid when applied locally produces redness, vesication, and ultimately slight sloughing. Internally it causes severe gastritis.

Therapeutics.—Acetic acid is applied externally to *indolent ulcers* of the mouth and *canker sores.* A weak solution may be used as a gargle in cases of *pharyngitis* or *sore throat.* Glacial acetic acid may be applied to *fungous growths* in the mouth. It is also used to remove *warts* and *corns.* The dilute acid or vinegar is especially indicated as an antidote in cases of poisoning by alkalies. The quantity to be given must be governed largely by the probable amount of alkali to be neutralized. In bleaching teeth with sodium dioxid, or in using the caustic alkalies about the teeth, a weak solution of acetic

acid should be at hand to neutralize any alkali which may get on the soft tissues of the mouth.

ACIDUM TRICHLORACETICUM—U. S. P.

(Trichloracetic Acid; $HC_2Cl_3O_2$.)

Trichloracetic acid occurs as white, deliquescent crystals, freely soluble in water, alcohol, and ether. It is made by acting on glacial acetic acid with chlorin or on hydrated chloral with fuming nitric acid.

Physiologic Action and Therapeutics.—Trichloracetic acid acts as an escharotic, astringent, and hemostatic. A solution of 5 to 10 per cent. may be applied to *indolent ulcers*, *mucous patches*, etc. A 10 to 20 per cent. solution is an excellent stimulating agent to be forced through a *sinus* in *chronic alveolar abscess* and into a *stubborn pyorrheal pocket.* It may also be employed in this strength solution as a hemostatic in case of *profuse hemorrhage* after the removal of the pulp by pressure anesthesia. The pure drug or in concentrated solution has been employed to some extent for the removal of small growths about the mouth, such as *hypertrophied gum* or *pulp tissue.* The agent is also used for the removal of *warts* and *corns.*

Monochloracetic Acid. ($HC_2H_2ClO_2$).—This agent occurs as a white crystalline substance, soluble in water and alcohol. As shown by the formula, only one of the hydrogen atoms in glacial acetic acid is displaced by chlorin. Harlan recommended the use of this agent in the treatment of *putrescent canals* of teeth. The remedy never gained any favor, as its action is uncertain.

ACIDUM LACTICUM—U. S. P.

(Lactic Acid; $HC_3H_5O_3$.)

Lactic acid is an organic acid usually obtained by the fermentation of grape-sugar or milk-sugar. The official preparation is composed of 75 per cent. absolute lactic acid and 25 per cent. of water and occurs as a syrupy liquid. Besides being miscible with water, it will mix with alcohol and ether in all proportions. The dose is about 30 min. (2.0 c.c.).

Physiologic Action and Therapeutics.—Lactic acid acts as a mild caustic on mucous surfaces. It is also a stimulant and refrigerant. Younger advocates the use of the official acid (75 per cent.) as a stimulating agent in *pyorrhea alveolaris.* After the roots are scaled, the acid is warmed and injected into the pockets. Stevens recommends a 20 to 50 per cent. solution to be applied to *tuberculous* and *lupous ulcerations of mucous membranes.*

ARSENI TRIOXIDUM—U. S. P.

(Arsenic Trioxid; Arsenous Acid; White Arsenic; As_2O_3.)

Arsenic trioxid occurs as a white powder or in heavy masses. It has neither odor nor taste. Sparingly soluble in water and alcohol; soluble in 5 parts of glycerin, and readily soluble in acids and alkalies. In the presence of water it reacts and forms arsenous acid (H_3AsO_3). The dose is from 1/60–1/20 gr. (0.001–0.003 gm.).

Physiologic Action.—Internally administered in the proper form and dose arsenic acts as an alterative. It is the *local action* with which dentists are mostly interested. Applied to denuded surfaces, such as an exposed pulp, unless its action is controlled, arsenic trioxid is a powerful and painful escharotic. It is readily absorbed by the tissue, and exerts a specific poisonous action upon the cells. It is a peculiar escharotic, and stands in a class by itself. Long[1] states that "the dry powder may be placed on the tongue and allowed to remain for one minute without causing the slightest irritation and, if then thoroughly removed, without producing any effect upon the tissues. On the contrary, if it is allowed to remain until it becomes dissolved and penetrates the tissues, extensive sloughing will result. It acts only after being absorbed by the tissue elements, altering or destroying their vital processes in an obscure manner. Because of this action it is difficult, if not impossible, to limit or antagonize its influence upon the tissue which it has penetrated; and its penetration is not limited by any action of its own, as it does not coagulate albumin. The fact of its being tasteless and nonirritating at first renders its use about the mouth the more dangerous, for by careless handling it may become lodged about the teeth or beneath the edge of the gum, and its presence be not appreciated for hours, until divitalization of the tissue has begun."

Under certain conditions, which are not well understood, the pulp tissue, though exposed, will absolutely resist the action of arsenic trioxid. When this occurs the tissue will generally be found to be equally resistant to other drugs. It is claimed that many of the peasants of Austria have acquired a toleration for the drug, and can take large doses without any untoward effects.

Poisoning and Treatment.—Arsenical poisoning may well be considered in two forms—*local* and *systemic*. *Local arsenical poisoning* occurs most frequently by the escape of arsenical preparations from the cavity in the devitalization of pulp tissue. There is seldom any

[1] Dental Materia Medica, Therapeutics and Prescription Writing.

pain connected with the divitalization of the gum tissue, and herein lies the great danger of extensive necrosis of the soft and frequently the bony structures. The prominent symptom is a white gum, absolutely lifeless; there may be pain, most frequently this symptom is absent; the tooth becomes sore to percussion. In the more severe cases the destruction of soft tissue, if unnoticed, goes on until the alveolar process between the affected teeth becomes involved and is destroyed. Sometimes the affected tooth is lost, together with one or two teeth on either side.

In the *treatment of local arsenical poisoning* where the drug has remained only long enough to cause devitalization of the gum tissue, all that is necessary is to first wash the part with an antiseptic solution and then mechanically pick off the dead or sloughed tissue with sterile pliers until hemorrhage ensues, if this is possible; after which stimulating disinfectants should be employed. Here is a good place to use the official solution of hydrogen dioxid. The cavity is open and there is no danger of spreading a possible infection. After removing the dead tissue and disinfecting, the author suggests drying the part and covering it with the oleoaginous euroform paste. The patient should be instructed to keep the mouth clean by the use of an antiseptic wash, and the local treatment repeated every day until granulations begin to form; usually one or two treatments will suffice.

In those severe cases where the agent has penetrated to and devitalized the alveolar process, as well as the overlying soft tissue, the first treatment is surgical. After washing with an antiseptic solution, the affected part should be thoroughly curetted with a bone curet or a suitable bur in the engine. It may be necessary in extensive cases to extract the affected tooth, after which the treatment is practically the same as has been outlined above, except where there has been much removal of tissue in operating it is best to pack the part at first with plain gauze thoroughly saturated with the euroform paste. The case should be watched closely, and the stimulating treatment kept up until the part has healed. The tissue in the interproximal space will never be fully reproduced, and will always be the source of more or less annoyance.

Acute systemic arsenical poisoning is manifested by severe abdominal pains, vomiting and purging of "rice-water," persistent thirst, muscular cramps, cyanosis, and collapse. Death usually occurs in from one to three days, and is often preceded by delirium, convulsions, and coma. If recovery follows, the acute symptoms may be gradually replaced by those of *chronic arsenical poisoning*. This condition may

also follow the prolonged use of the drug as a medicine, may result from the use of foods or liquors contaminated with arsenic (beer, etc.), may occur from constant inhalation of dust arising from wall-paper or other fabrics colored with arsenical pigments, or may be acquired by workmen in arsenic mines, or in factories in which fumes of the metal are formed. This form of poisoning may be manifested by gastroenteritis, conjunctivitis, and catarrh of the upper air-passages, anemia, peripheral neuritis, and various cutaneous lesions.

In the treatment of *acute systemic arsenical poisoning*, emetics should be promptly given or the stomach emptied by means of the stomach-pump. The best chemic antidote is freshly prepared ferric hydroxid or ferric hydroxid with magnesia, administered while moist in doses of a tablespoonful or more every ten or fifteen minutes. These compounds themselves are harmless and act by forming insoluble arsenites. Dialysed iron liberates in the stomach a certain amount of free ferric hydroxid and may also be given. This agent has also been recommended in local arsenical poisoning, but its use here is both worthless and wrong (see p. 287). Demulcents and opiates are usually indicated.

Therapeutics.—Arsenic trioxid is used only in dental practice for the purpose of *devitalizing the pulp tissue*. The agent was introduced to the dental profession by Spooner, of Montreal, in about 1836. He first advocated its use for the treatment of sensitive dentin, for he discovered that by sealing the drug in a cavity for a few days, the most sensitive dentin yielded to its influence. The fact, however, that nearly all teeth thus treated subsequently gave trouble because of the death of the pulp and the usual sequelæ, led the profession to abandon this agent for the purpose for which it was introduced; but it has ever since been used as a means of destroying the vitality of the pulp. In fact, until the last few years, it was the only agent employed with any satisfaction. The detail method of using arsenic troixid as a devitalizing agent will be discussed later.

CHROMII TRIOXIDUM—U. S. P.

(Chromium Trioxid; Chromic Acid; CrO_3.)

Chromium trioxid, called also chromic acid, occurs in small, crimson crystals or rhombic prisms. The drug is without odor, very deliquescent, and thus freely soluble in water. It should be kept in glass-stoppered bottles, and great caution should be observed to avoid an explosion when brought in contact with organic substances, such as cork, tannic acid, sugar, alcohol, glycerin, ether, and collodion.

Physiologic Action and Therapeutics.—Chromic acid is an active escharotic, due to its powerful oxidizing influence. Internally administered, it causes intense pain in the abdomen, vomiting and purging, oftentimes with blood in the vomited matter and stools, ultimate collapse, and frequent death. Alkalies neutralize the compound, but the salts thus formed are poisonous and the stomach should be emptied after the administration of the antidote. Chromium trioxid has been employed for the purpose of devitalizing the pulp tissue in children's teeth. Though the agent may be considered safer than arsenic trioxid, because it is less penetrating, its action is uncertain and unreliable. Stevens recommends a solution of from 20–30 gr. (1.3–2.0 gm.) to the ounce (30.0 c.c.) as a stimulating application in *mucous patches*. The fused crystals on a suitable probe may be used with excellent results in the removal of *hypertrophied gum or pulp tissue*, and in closing small *salivary fistulæ*.

Incompatibles.—With organic substances, such as cork, tannic acid, alcohol, glycerin, etc., chromic trioxid easily explodes.

Potassium Dichromate ($K_2C_2O_7$).—This salt, sometimes called potassium bichromate, may be employed in weak solutions (5 per cent.) in *indolent ulcers*, *mucous patches* and *sloughing wounds*.

OSMII TETROXIDUM.

(Osmium Tetroxid; Osmic Acid; OsO_4.)

Osmium tetroxid, called also osmic acid, occurs in yellow, crystalline needles, possessing a pungent odor and burning taste. It is freely soluble in water, alcohol, and ether.

Physiologic Action and Therapeutics.—This is a very irritant and caustic agent. When injected into the tissues, even in weak solutions, the blood and tissue turn black, but healing of the wound generally proceeds without interruption. Its use has been confined to the treatment of *neuralgia*. Murphy, Bennett, and others claim excellent results. The affected nerve is exposed by a small incision, and a 1.5 per cent. solution, freshly prepared, is injected into its substance at different points, to the amount of from 5–10 min. (0.3–0.6 c.c.).

POTASSII ET SODII—Unofficial.

(Kalium and Natrium; Potassium and Sodium; K and Na.)

Potassium and **sodium** are known in chemistry as *alkali-metals;* they vigorously decompose water at ordinary temperatures, forming the hydroxid (hydrate) of the metal, with liberation of hydrogen. The

metals occur in soft cylinders, having a silver-white color; and on account of their tendency to combine with oxygen they must be kept under a hydrocarbon liquid, such as coal-oil, benzene, etc.

Action and Therapeutics.—Because of their violent action on soft tissue they are not used as such in medicine. Schreier, of Vienna, introduced a mixture of these metals as a remedy for treating *putrescent root-canals.* When the mixture is placed in a canal containing dead pulp tissue a violent reaction takes place, water is decomposed, with the evolution of considerable heat, and the hydroxids of the metals are formed. The potassium and sodium hydroxids unite with the fatty products present to form soluble soap, which may be removed by washing. Thus it will be seen that the contents of the canal are chemically destroyed and physically removed, leaving the canal white and clean. Rhein recommends a further sterilization of the canal with a 1:500 solution of mercury bichlorid in a 3 per cent. solution of hydrogen dioxid.

POTASSII HYDROXIDUM—U. S. P.

(Potassium Hydroxid; Caustic Potash; KOH).

Potassium hydroxid, more commonly called caustic potash, occurs in hard, white, translucent pencils or fused masses, odorless, and having an acrid and caustic taste. It is freely soluble in water and in alcohol. The official preparation is:

Liquor Potassii Hydroxidi, U. S. P. (5 per cent.).

SODII HYDROXIDUM—U. S. P.

(Sodium Hydroxid; Caustic Soda; NaOH).

Sodium hydroxid, or caustic soda, occurs in hard, white, translucent pencils or fused masses, odorless, and having an acrid and caustic taste. It is freely soluble in water and in alcohol. The official preparation is:

Liquor Sodii Hydroxidi, U. S. P. (5 per cent.).

Physiologic Action and Therapeutics.—The action of caustic potash and caustic soda is similar. They may be classed among the strongest and most penetrating escharotics known. They should be handled about the mouth and other soft tissues with the greatest caution. Their action is both rapid and painful. When applied to soft tissue they produce a slough which separates in a few days leaving a granulating ulcer. The escharotic effect is caused by the abstraction

of water from the tissues; this softens the latter, and the hydroxyl radical forms with the proteids a soluble alkaline albuminate. When either are taken internally in large doses they produce all the symptoms of corrosive poisoning—burning in the throat and esophagus, intense pain in abdomen, vomiting and purging of mucous and bloody matter, dysphagia, and ultimate collapse. Small doses freely diluted have the same action as the alkaline carbonates—that of an *antacid.*

Caustic potash and caustic soda are sometimes employed in dental practice to destroy *exuberant granulations.* They are also used in about 10 per cent. solutions to cauterize and destroy a *remnant of a pulp.* Whenever these alkalies are employed in the canals of teeth, care must be taken so as not to force them through the root end, and their caustic action should be neutralized with weak acids.

Treatment of Poisoning.—The treatment of poisoning with the caustic alkalies to be effective must be prompt. Dilute acetic acid or vinegar will neutralize the alkali and should be given at once. Demulcent drinks are indicated to soothe the corroded parts, and opium to control the pain.

Hydrofluoric Acid (HF).—This is a colorless gas, freely soluble in water. It may be obtained commercially in solution, and because of its power to etch glass, it must be kept in rubber or gutta-percha bottles. On account of its extremely irritating and penetrating property, it is not employed as a therapeutic agent, but is used extensively in dentistry for etching porcelain inlays. It must be handled with the greatest care, for if it is accidentally applied to the soft tissue and not instantly neutralized it will penetrate deeply and produce an ugly ulcer. Many cases of severe local poisoning by the agent have been reported, and it is for this reason largely that it has been included in this work on therapeutics.

The treatment of local poisoning consists in neutralizing the drug chemically by the use of alkalies. A weak solution (5 per cent.) of ammonia water serves the purpose nicely, and the sooner the application is made after the discovery of the burn, the less destruction of tissue there will be. To apply the antidote, the part can be wrapped in plain sterile gauze and this saturated with the remedy. The ammonia will irritate the part and probably cause pain, but the acid must be neutralized, even at the expense of causing pain. After we are reasonably certain that the acid is neutralized, the burn should be antiseptically treated in the usual way. The euroform paste is an excellent remedy to employ.

Actual Cautery.—The cauterization of tissue by means of

heat should be considered briefly under the heading of *Escharotics*. This is accomplished by means of the hot iron or the galvano-cautery, and affords a prompt and powerful means of destroying tissue. Though not as painful as one would naturally suppose, the process is seldom employed to-day in dentistry.

IRRITANTS AND COUNTERIRRITANTS.

Irritants have been elsewhere defined as agents which, when applied to the skin or mucous membrane of the mouth, produce active hyperemia or inflammation. When irritants are applied to a normal part for the purpose of influencing favorably a diseased part, usually deep-seated, they are called **counterirritants,** and the process *counter-irritation*. It is for this latter purpose that irritants are largely employed in dentistry. The extent to which counterirritation may be carried depends upon the severity of the diseased part which the irritation of the normal part is intended to influence. The agents used are sub-divided into different classes according to the degree of irritation following their application. Those which simply produce active hyperemia (redness) of the surface are called *rubefacients;* those which act more severely and cause the formation of a blister are known as *vesicants* or *episplastics*. In many instances the same agent may produce a rubefacient or a vesicant effect, depending upon the strength of the drug and the duration of its application.

Counterirritation may be carried to a greater degree of intensity when a true escharotic effect (destruction of tissue) is produced. This, however, is seldom necessary in dental practice. In fact, as a rule, it should be guarded against, for the formation of an ulcer in the mouth is liable to so cripple the cells that a *mixed infection* may readily follow.

Care should be exercised in the application of counterirritants when the inflammation is superficial. To apply an irritant directly to an inflamed part would only tend to aggravate the condition. Here the site of application should be a short distance from the diseased part. In all deep-seated inflammations, or in cases of neuralgia, it is best to make the application directly over the affected part.

Long[1] states that "the remedial effect of a counterirritant is probably brought about by a threefold action. They influence, *first*, the circulation by causing a hyperemia at the point of irritation, the tendency of the blood supply will be in that direction and away from the original disease; *second*, they turn the attention of the system

[1] Dental Materia Medica, Therapeutics and Prescription Writing.

toward the new point of irritation and away from the disease, partly a mental effect; and, *third*, they influence the innervation of the diseased part by the reflex influence of the irritation. In the sum of their effects they stimulate the movement of fluids within the tissues; hence they are regarded as lymphatic stimulants, and are often employed to stimulate the absorption of a serous or inflammatory exudate."

Counterirritation may be said to be truly indicated in dental practice in the treatment of *pericementitis*, and *trigeminal neuralgia*.

The most important irritants used in dentistry for counterirritation are:

Heat.	Cantharides.
Iodin.*	Chloroform.
Capsicum.	Aconite.
Mustard.	Camphor.
Oil of Turpentine.	Volatile Oils.
Menthol.	

Heat.—This physical agent occupies a prominent place in dentistry as a counterirritant, because of the convenience of the variety of forms and the different degrees in which it can be utilized. Moderate heat applied over a deep-seated inflammation will at once produce active hyperemia. The heat may be gradually carried to a higher degree with comfort to the patient until the serum escapes from the engorged blood-vessels, thus promoting *resolution*. Hot water, the hot-water bag, hot foot-bath, and dry and moist poultices, are all employed in various manners in the treatment of *pericementitis*, and *acute alveolar abscess*.

CAPSICUM—U. S. P.

(Cayenne Pepper.)

Capsicum is the *dried ripe fruit* of *Capsicum fastigiatum*, a plant growing in tropical America, in Asia, in Africa, and cultivated in gardens. The active principle is *capsicin*, which appears in the form of colorless crystals and has an exceedingly pungent odor; other constituents are a volatile alkaloid, fixed and volatile oil, and fatty acids. The dose is from 1–3 gr. (0.06–0.2 gm.). All of the official preparations may be used in dentistry. They are:

Tinctura Capsici, U. S. P. *Dose*, 10–20 min. (0.6–1.3 c.c.).
Fluidextractum Capsici, U. S. P. *Dose*, 1–2 min. (0.06–0.12 c.c.).
Oleoresina Capsici, U. S. P. *Dose*, 1/4–1 min. (0.016–0.06 c.c.)
Emplastrum Capsici, U. S. P. (externally).

Physiologic Action.—Applied to the skin or mucous membrane, capsicum produces a burning sensation and results in a rubefacient or vesicant effect depending upon the concentration of the drug. Taken internally, in medicinal doses, it creates a sense of warmth in the stomach, stimulates the circulation, and aids the digestive process. In large doses it acts as an irritant poison.

Therapeutics.—Capsicum is used chiefly as a rubefacient, stomachic, and carminative. In dentistry advantage is taken of its irritant properties, and it is largely employed as a counterirritant in *pericementitis.* The oleoresin is the most irritating preparation. The official plaster may be prepared by spreading the oleoresin upon resin plaster; this may be cut in convenient form and applied to the dried gum over the affected tooth, resulting in a small blister, but having a beneficial effect upon the deep-seated inflammation. When a rubefacient effect only is desired, the powdered drug may be confined in small concave rubber disks and pressed on the gum, the suction holding the remedy in place.

SINAPIS ALBA—U. S. P.
(White Mustard.)

SINAPIS NIGRA—U. S. P.
(Black Mustard.)

White mustard is the *seed* of Sinapis alba. **Black mustard** is the *seed* of Brassica nigra. Both of these herbs are cultivated extensively in Europe and America. The powdered mustard of commerce is a ground mixture of white and black seed, often more or less adulterated. Mustard in the dry state is not irritating, but in the presence of water it is extremely irritating, and for this reason: White mustard contains a ferment, *myrosin,* and a glucosid, *sinalbin.* In the presence of water the myrosin acts upon the sinalbin and separates from it an irritant volatile oil.

Black mustard contains the same ferment, *myrosin,* and a glucosid, *sinigrin,* which by the action upon it of the ferment in the presence of water also converts it into an intensely irritant volatile oil. This oil of mustard is official, and to it is due both the pungent taste and odor of the moistened powder. Dose, 1–4 drams (4.0–16.0 gm.). The following preparations are official:

Charta Sinapis, U. S. P.
Oleum Sinapis Volatile, U. S. P. (Volatile Oil of Mustard).

Physiologic Action.—Mustard made into a paste with water and applied to the skin or applied to the moist mucous membrane causes redness, heat, and a burning pain. Any degree of irritation, from a slight rubefacient effect to severe vesication, may be produced. It should be remembered that the presence of moisture is necessary for the irritant action of mustard, the dry powder is not irritating. Hot water should not be used, as the high heat tends to destroy the ferment necessary to evolve the irritating oil from the glucosid.

Taken internally in small doses, mustard acts as a carminative. In large doses it acts as an emetic, producing prompt emesis without depression, owing to the reflex stimulation of the cardiac and respiratory centers.

Therapeutics.—Mustard is useful in dentistry as a rubefacient. The official paper, cut in proper form, may be applied to the *moist* gum in *nonseptic pericementitis*. Concave rubber cups may also be used and applied by suction. Powdered mustard may be added to warm water to bring about the reaction necessary to produce the irritant volatile oil, and this added to the hot water in taking a hot foot-bath for counterirritant purposes. To add the mustard direct to the hot water would defeat the object for which the drug is used, as the heat checks the action of the ferment.

On account of the prompt emetic properties of mustard the drug may be employed in cases of *narcotic poisoning*, the dose being a tablespoonful stirred up in warm water, and repeated in fifteen minutes, if necessary

The drug is sometimes used in *neuralgia* and *muscular rheumatism*. The blisters produced by mustard heal with difficulty; therefore, extensive vesication should be guarded against.

TEREBINTHINA—U. S. P.

(Turpentine.)

Turpentine is a *solid oleoresin*, or pitch, obtained from *Pinus palustris* and other species of *Pinus*, growing in the Southern United States, especially in North Carolina. The oleoresin exudes from the pine tree when the bark is cut, and when subjected to distillation it yields a volatile oil, which is official, and a solid residue called resin or rosin, also official.

OLEUM TEREBINTHINÆ—U. S. P.

Oil of turpentine is a thin, colorless liquid, highly inflammable, and of a characteristic odor and taste. It should be kept in well-

stoppered bottles, protected from light. The rectified oil is made by distilling the ordinary oil with lime-water. This is the preparation which is largely used in dentistry and the one always used for internal medication. Dose is from 5–15 min. (0.3–1.0 c.c.) in emulsion. The official preparations are:

Oleum Terebinthinæ Rectificatum, U. S. P.
Emulsum Olei Terebinthinæ, U. S. P. (15 per cent.).
Liniment Terebinthinæ, U. S. P. (35 per cent. with Resin Cereate).

Physiologic Action.—When applied to the skin, the drug dilates the cutaneous blood-vessels, producing a sensation of heat and redness, and, if continued long, vesication follows. The drug has decided antiseptic properties, and even in dilute solutions prevents fermentation and putrefaction. Taken internally in medicinal doses, it produces warmth in the stomach, quickened repiration, and increases the rate and tension of the pulse. It also acts as a circulatory stimulant and diuretic.

In large doses it produces all the symptoms of an irritant poison. Some individuals are peculiarly susceptible to the drug, and erythematous or papular eruption may result from either its internal or external use.

Therapeutics.—Externally, oil of turpentine may be used as a rubefacient in various inflammatory affections. In an *acute alveolar abscess* a turpentine stupe may be employed to advantage. The latter is made by soaking a large piece of flannel in boiling water and wringing dry and folding it several times until it is about six inches square, then from 10 to 30 drops of the oil is distributed, when it should be quickly applied to the cheek of the affected side and covered with several layers of fabric. The official liniment makes an excellent remedy to be applied in cases of *neuralgia* and *muscular rheumatism.*

TEREBENUM—U. S. P.

(Terebene.)

This is a liquid hydrocarbon made by oxidizing oil of turpentine with strong sulphuric acid. The dose is from 5–10 min. (0.3–0.6 c.c.).

Terebene has proved to be a very satisfactory remedy in *bronchitis* with free expectoration. It has also been used in *phthisis,* and may be inhaled from a spray or from the sponge of a respirator. Harlan recommended its use for *putrescent root-canals;* but, like the essential oils, its use here is unreliable.

CANTHARIS—U. S. P.

(Cantharides; Spanish Flies.)

Cantharides, commonly called Spanish fly, is the *dried* and *powdered beetle* or *insect*, *Cantharis vesicatoria*, indigenous to Southern and Central Europe. The active principle is *cantharidin*, which is also found in a number of beetles. The drug is used only externally in dentistry. The official preparations are·

Tinctura Cantharidis, U. S. P.
Ceratum Cantharidis, U. S. P.
Collodium Cantharidatum, U. S. P. (60 per cent.).

Physiologic Action.—Cantharides is a powerful irritant, though rather slow in its action. When applied to the skin or mucous membrane, the drug excites a tingling and burning sensation, producing redness and, later, vesication. Its long-continued application often results in pustulation, ulceration, and sloughing.

Butler states that the drug not only causes vascular dilatation of the part to which it is applied, but reflexly dilates the blood-vessels of the deep-seated organs underneath, thus acting as a counterirritant.

The active principle, cantharidin, may be absorbed through the unbroken skin, and is quite readily absorbed through the mucous membrane, thus its constitutional effects may result from the external use of the drug. The toxic symptoms are great pain in the throat, stomach, and bowels, excessive thirst, irritation of the genitourinary tract with a desire to urinate constantly, albuminous and bloody urine, painful erections of the penis in males, and in women abortion may follow the irritant effect of the drug upon the pelvic viscera. While these symptoms are not liable to follow the use of the drug in dental practice where a limited area is selected as the site of application for counterirritant purposes it is, nevertheless, well to be familiar with them.

Treatment of Poisoning.—The stomach should be emptied, and demulcents given freely to relieve the irritation. Opium may be required to relieve the pain, and stimulants administered, if necessary. Oils and fatty substances dissolve the cantharidin, and thus hasten its absorption; they should therefore be avoided as demulcents.

Therapeutics.—Cantharides may be used as a counterirritant in cases of *severe pericementitis*, and as it dilates the arterioles subjacently, the effect of the drug will ultimately afford relief. Its action is slow but certain. The cereate may be applied as a plaster or the

collodion as a varnish. To insure greater activity of the drug, the site of application should be oiled. In *facial neuralgia* cantharides is valuable, the preparation being applied behind the ear

ACONITUM—U. S. P.

(Aconite; Wolfsbane; Monkshood.)

Aconite is official in the form of the *dried tuberous root* of *Aconitum napellus*, a plant growing in Europe, Asia, and in America, mostly in mountainous regions. The root closely resembles horse-radish; the latter, however, has a pungent odor when scraped, while aconite is odorless. The root at first has a sweetish taste, but soon produces a sense of warmth and tingling, followed by numbness. The active principle is *aconitin*, also official under the title **aconitina**, U. S. P. This is an alkaloid, occurring in colorless or white rhombic prisms or prismatic powder, without odor, and permanent in the air, and when brought in contact with the mucous membrane, even in dilute solutions, produces a characteristic tingling and more or less anesthesia. The dose of aconitin is from 1/500–1/200 gr. (0.00013–0.0003 gm.). The official preparations of aconite are:

Tinctura Aconiti, U. S. P. (10 per cent.; 35 per cent., U. S. P., 1890.) *Dose*, 5–15 min. (0.3–1.0 c.c.)
Fluidextractum Aconiti, U. S. P. *Dose*, 1–2 min. (0.06–0.12 c.c.)
Linimentum Aconiti (not official; externally).

Physiologic Action.—Aconite is a true circulatory depressant. It may also be considered a nervous sedative. Applied to the mucous membrane or to the skin for any length of time, it first irritates, causing stimulation, and then depresses the sensory nerve-endings, producing, respectively, tingling, numbness, and local analgesia. The drug lowers the blood pressure by directly depressing the heart. In the febrile state, moderate doses of aconite cause a decided fall of temperature. Butler claims this is due to various causes: (1) The slowing of the circulation, diminishing the metabolism; (2) the peripheral action of the drug, causing dilatation of the cutaneous blood-vessels; (3) the depressant action upon all muscle-tissue.

Toxicology.—Poisoning by aconite is first manifested by a peculiar tingling sensation of the tongue and lips, soon extending to the fingers, and may affect the entire surface of the skin. The pulse becomes slow and weak, later it may become rapid and irregular; the

respiration is slow and feeble. There is an extreme muscular weakness, especially noticeable in the lower extremities.

Treatment of Poisoning.—The patient should be kept in a recumbent position, the feet slightly raised. The stomach should be thoroughly emptied, keeping patient in this position. External applications of heat should be made to raise the temperature, and diffusible stimulants, such as alcohol and aromatic spirit of ammonia, should be given; strychnin, atropin, and digitalis may be hypodermically administered for their effect upon the cardiac and respiratory centers; and, if necessary, artificial respiration should be employed.

Therapeutics.—Though the first effect of aconite, locally applied, is that of an irritant, it has not been discussed here because of this property; but rather for the reason that certain preparations of the drug, notably the tincture, have long been used in dental practice as a constituent of counterirritant remedies for the treatment of *apical pericementitis* and *facial neuralgia.* Tincture of aconite has been extensively used to dilute the tincture of iodin for dental purposes. A favorite liniment of the author's for *nonseptic pericementitis* is: Menthol, 20 gr.; chloroform, 1 1/2 fl. dr.; tincture of aconite, 6 1/2 fl. dr. The therapeutics of aconite will be discussed more fully later.

CAMPHORA—U. S. P.

(Camphor; $C_{10}H_{16}O$.)

Camphor is a stearoptene obtained from *Cinnamomum camphora,* a tree indigenous to Eastern and Southeastern Asia, and cultivated in Italy as an ornamental tree. The drug occurs in white, translucent masses, of a tough consistence and crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform. It is sparingly soluble in water, but freely soluble in alcohol, ether, chloroform, fixed and volatile oils. When camphor is triturated in about equal proportions with menthol, thymol, phenol, or chloral hydrate, a syrupy liquid results. The dose is from 1–5 gr. (0.06–0.3 gm.). The following preparations are official:

Aqua Camphoræ, U. S. P.
Cereatum Camphoræ, U. S. P. (10 per cent.).
Linimentum Camphoræ, U. S. P. (30 per cent. in Cottonseed Oil).
Linimentum Saponis, U. S. P. (4.5 per cent.).
Spiritus Camphoræ, U. S. P. (10 per cent.).
Tincturæ Opii Camphorata, U. S. P. (Camphorated Tincture of Opium; Paregoric; 0.4 per cent.). *Dose*, 1–4 fl. dr. (4.0–16.0 c.c.).

Physiologic Action.—Upon the unbroken skin, camphor acts as an anesthetic; but on the mucous membrane it is irritating, and in concentrated form may produce inflammation and even sloughing. In medicinal doses it acts as a carminative and antispasmodic. In large doses, it causes confusion of thought, headache, gastric irritation, a rapid feeble pulse, convulsions, and collapse.

Therapeutics.—Camphor is used as a rubefacient, circulatory stimulant, and antispasmodic. The spirit of camphor has long been a household remedy for *headache, syncope,* and *faintness.* It is administered by inhalation; camphorated oil (5 per cent. of camphor in olive oil) is a useful remedy in *colds* and *croup.* The liniment, as well as the spirit, is extensively used in *sprains, bruises, muscular rheumatism,* and *neuralgia.* Prinz advocates a combination of thymol (2 parts), phenol crystals (2 parts), and camphor (1 part), called *thymocamphen,* as an anodyne in *root-canal treatment.* In *acute coryza,* Stevens recommends adding a teaspoonful of powdered camphor to a tumbler of hot water, and inhaling the fumes.

EMOLLIENTS, DEMULCENTS, AND PROTECTIVES.

Emollients are substances of a fatty nature which soften and relax the tissue to which they are applied, and at the same time shield the part from external irritation.

The most important emollients are:

- Glycerin.
- Soap Liniment.
- Starch.
- Hot Fomentations.
- Poultices:
  - Linseed Meal.
  - Oatmeal.
  - Bran.
  - Bread.
  - Flour.
  - Figs, etc.
- Fats and Oils:
  - Lard.
  - Olive Oil.
  - Almond Oil.
  - Linseed Oil.
  - Lanolin.
  - Petrolatum.
  - Paraffin.
  - Cacao Butter.
  - Wax.

Demulcents are substances largely of a mucilaginous character which soothe and protect the tissues to which they are applied. The important demulcents are:

- Acacia.
- Tragacanth.
- Licorice Root.
- Flax Seed.
- Marshmallow.
- White of Egg.
- Sassafras Pith.
- Slippery Elm.

Protectives are agents used to mechanically cover and protect injured or diseased surfaces from extraneous influences, as air, water, bacteria, etc. Some protectives, besides affording mechanical protection to the part, also absorb moisture or fluids by capillary attraction. The so-called *dusting powders* and *fixed dressings* are included in this group. The chief protectives are:

Collodion.	Talc.
Solution of Gutta-percha.	Kaolin.
Court Plaster.	Lycopodium.
Charcoal.*	Zinc Oxid.*
Animal Charcoal.*	Chalk.*
Purified Cotton.	Magnesium Carbonate.*

Emollient and demulcent are largely interchangeable terms, and no distinct division between the substances used as such can be made. The emollient, demulcent, and protective agents will, therefore, be discussed here without reference to the three subdivisions into which they have been grouped.

GLYCERINUM—U. S. P.

(Glycerin; $C_3H_5(OH)_3$.)

Glycerin is a syrupy liquid obtained by the decomposition of fats and fixed oils. It is clear, colorless, without odor, of a sweetish, warm taste, and when exposed to the air slowly absorbs moisture. Freely soluble in water and alcohol, but insoluble in ether, chloroform, and oils. Chemically considered, it is an alcohol. Dose is from 1–2 fl. dr. (4.0–8.0 c.c.). The following preparations are official:

Glyceritum Phenolis, U. S. P. (20 per cent. of Phenol).
Glyceritum Acidi Tannici, U. S. P. (20 per cent. Tannic Acid).
Glyceritum Amyli, U. S. P. (Starch, 10; Water, 10; Glycerin, 80).
Glyceritum Boroglycerini, U. S. P. (50 per cent. of Boroglycerin).
Glyceritum Hydrastis, U. S. P. (1.0 c.c. of preparation contains 1.0 gm. of Hydrastis).
Glyceritum Ferri, Quininæ, et Strychinæ Phosphatum, U. S. P. *Dose*, 10–30 min (0.6–2.0 c.c.).
Gelatinum Glycerinatum, U. S. P. (equal parts of Gelatin and Glycerin).
Suppositoria Glycerini, U. S. P. (each Suppository contains 45 gr.–3.0 gm. of Glycerin gelatinized by means of a Sodium Soap).
Cataplasma Koalini, U. S. P. (Kaolin, 57.7 parts; Glycerin, 37.5 parts; Boric Acid, 4.5 parts; Methyl Salicylate, 2 parts; Thymol and Oil of Peppermint, each 1/2 part).

Glycerin is also a constituent of many extracts and fluid extracts, added largely to preserve the preparations.

Physiologic Action.—When glycerin is applied to sensitive skin or mucous membrane, it has a tendency to irritate, due to the abstraction of water from the tissues. Taken internally, in large doses, glycerin acts as a cathartic, its action here probably being due also to its hygroscopic property. It is antiseptic in that it inhibits, to an extent, microorganic growth. Authorities differ as to whether or not glycerin in moderate doses acts as a food.

Therapeutics.—Externally applied, glycerin is an efficient and popular emollient. For *chapped hands* and *after shaving* the following lotion is valuable: Witch-hazel and bay-rum, each 1 fl. oz. (30.0 c.c.); glycerin, 1 fl. oz. (30.0 c.c.); borax, 1/2 dr. (2.0 gm.). The official cataplasm of kaolin, applied hot, is an excellent substitute for ordinary poultices where the latter are indicated. In *inflammatory disease of the mouth, throat, and nose,* glycerin is used to advantage as a vehicle for other drugs.

Glycerite of boroglycerin is a constituent of many *antiseptic mouth-washes;* and glycerite of tannic acid may be added, 1/2 fl. dr. to the fl. oz. (2 c.c.–30.0 c.c.), to mouth-washes to add astringency. Glycerite of tannic acid may also be applied to *flabby* and *inflamed gums.* The glycerin not only depletes the engorged capillaries, but also serves to spread the drug contained therein over the entire surface.

Internally it is largely employed in *habitual constipation.* Here the official suppository may be employed.

Incompatibles.—Powerful oxidizing agents, like sodium dioxid, chromic acid, and potassium permanganate, explode with glycerin.

AMYLUM—U. S. P.

(Starch; $C_6H_{10}O_5$.)

Starch is a white powder, or masses, obtained from the fecula of the *seed* of *Zea mays,* or Indian corn. Wheat starch (flour) and rice starch are also used in therapeutics. It is insoluble in water; soluble in boiling water. There is only one official preparation:

Glyceritum Amyli, U. S. P. (10 per cent.).

Therapeutics.—Starch is used externally in the form of dusting powder or "pastes" as protective applications. It is an antidote for *iodin poisoning,* the insoluble starch iodid being formed.

In pharmacy the glycerite of amyl is used as an excipient for making pill-masses of certain drugs.

OLEUM OLIVÆ—U. S. P.

(Olive Oil; Sweet Oil.)

Olive oil is a fixed oil expressed from the *ripe fruit* of *Olea europea,* a shrubby tree indigenous to western Asia, but cultivated in several countries, including the southern United States, especially California. The oil is a pale yellow or light greenish-yellow liquid, of a characteristic odor, and an oleaginous taste. It should be kept in well-stoppered bottles, in a cool place. Dose 1 fl. oz. (30.0 c.c.). It is a constituent of unguentum diachylon, U. S. P.

Physiologic Action and Therapeutics.—Olive oil is a bland and agreeable oil, and is used extensively as an emollient and demulcent. It is readily absorbed from the skin and mucous membrane, and with phenol (5 per cent.) it makes a soothing, protective application for superficial *wounds, bruises, burns, insect bites, stings, etc.* Camphorated olive oil (camphor 5 per cent.) is a useful remedy to rub on the throat and chest in cases of *colds* and *croup* in children.

In cases of *poisoning from corrosive irritating drugs,* olive oil is a valuable demulcent, unless the poison be soluble in an oil, in which case any fat or oil is contraindicated, as it would tend to hasten the absorption of the poison. Internally administered, olive oil is not only demulcent, but possesses marked nutritive and laxative properties. It is often taken in wines and liquors for its nutritive value.

LINUM—U. S. P.

(Linseed; Flaxseed.)

Linseed is the *ground seed* of *Linum usitatissimum,* or common flax, which is cultivated in all temperate countries. Its chief ingredients are a fixed oil and a mucilaginous principle. The oil (Oleum Lini, U. S. P.) is official, and enters as an essential constituent into the following preparations:

Linimentum Calcis, U. S. P.
Sapo Mollis, U. S. P. (Soft Soap).
Linimentum Saponis Mollis, U. S. P.
Liquor Cresolis Compositus, U. S. P.

Physiologic Action and Therapeutics.—An infusion or tea of faxseed makes an excellent *demulcent drink.* The ground flaxseed is probably used for the ordinary poultice *in deep-seated inflammations* more than any other substance. The oil is similar to olive oil in its action and uses. Mixed with an equal quantity of lime-water, it makes

the official linimentum calcis, commonly called carron oil, an excellent remedy for the treatment of *burns*. The liniment of soft soap, called tincture of green soap, should be in every dental office, and used frequently on the *hands for detergent purposes*.

ADEPS LANÆ—U. S. P.

(Lanolin; Wool-fat.)

Lanolin, or **wool-fat,** is the *purified fat* of the *wool* of sheep, freed from water. It is a yellowish-white, unctuous substance, having a faint peculiar odor. The Pharmacopeia also recognized a wool-fat which contains about 30 per cent. of water (Adeps Lanæ Hydrosus, U. S. P.)

Therapeutics.—Lanolin is extensively used as a vehicle for ointments. It is bland and unirritating, does not become rancid, and has the distinct advantage of being miscible with twice its weight of water without losing its ointment-like character. With this vehicle, therefore, aqueous substances may be made into ointments. It is used as the vehicle for *devitalizing pastes* for the dental pulp. The hydrous wool-fat, in pharmacy, is used as a constituent in many of the official ointments.

PETROLATUM—U. S. P.

(Vaselin; Cosmolin.)

Petrolatum is a mixture of hydrocarbons, chiefly of the methane series, obtained by distilling off the more volatile portions of petroleum and purifying the residue. The melting-point should be between 45° and 48° C. Three forms are official: Petrolatum, U. S. P. (ordinary petrolatum), a yellowish, ointment-like mass; Petrolatum Album, U. S. P. (white petrolatum), a white ointment-like mass, and Petrolatum Liquidum, U. S. P. (liquid petroleum), a clear, colorless, oily liquid.

Therapeutics.—Petrolatum is bland and unirritating, and is extensively used as an emollient and protective dressing. It is largely substitued for benzolated lard in ointments. Phenolized vaselin (3 per cent. phenol) is a household remedy for *burns*, *bruises*, and other *excoriations*. An ointment made from orthoform (40 parts) and europhen (60 parts), with liquid vaselin as the vehicle, is a specific for pain following the *extraction of teeth* where the alveolar process has been exposed; it acts here also as an emollient and protective. Liquid vaselin containing 2 per cent. of menthol is an excellent emollient to be used as a spray in *acute coryza*.

PARAFFINUM—U. S. P.

(Paraffin.)

Paraffin should be discussed in connection with *petrolatum.* It is a mixture of solid hydrocarbons obtained from the same source. It is a white solid, and should melt between 51.6° and 57.2° C.

Therapeutics.—Gersung, in 1900, recommended the subcutaneous and submucous injections of paraffin for the correction of various defects and for cosmetic purposes. Beck, of Chicago, has employed the method quite extensively for the correction of nasal deformities; and paraffin has also been injected about the jaws with excellent results in cases of *necrosis* and other *diseases where bone tissue has been lost or removed.* The paraffin should be sterilized by boiling and must be injected with a specially prepared syringe while warm and semisolid. This substance when so injected is not absorbed, but finally becomes encapsulated. Paraffin has also been used for filling root-canals.

ACACIA—U. S. P.

(Gum Arabic.)

Acacia is a *gummy exudation* obtained from *Acacia senegal,* and other species of *Acacia,* a small tree, deeply and firmly rooted, growing in India, Africa, and other countries. It is soluble in water. The following preparations are official:

Mucilago Acaciæ, U. S. P. *Dose,* freely.
Syrupus Acaciæ, U. S. P. *Dose,* freely.

Therapeutics.—Acacia is used in therapeutics chiefly for its demulcent property. The mucilage may be further diluted with water and administered freely in cases of *poisoning from corrosive drugs.* In pharmacy it is the *emulsifying agent* generally employed in making emulsions of oleaginous drugs; it is also used in pills and lozenges for holding together the active ingredients.

Incompatibles.—It is incompatible with alcohol, ferric salts, and borax.

TRAGACANTHA—U. S. P.

(Tragacanth.)

Tragacanth is a *gummy exudation* obtained from *Astragalus gummifer,* a small shrub growing in western Asia. This gum differs

from acacia in that it does not dissolve in water, but swells up in it and forms a gelatinous mass. The official preparation is:

Mucilago Tragacanthæ, U. S. P.

Therapeutics.—Though possessing demulcent properties, it is impracticable to use it as such on account of its insolubility. The mucilage of tragacanth may be used as an emollient in *chapped hands* and other *skin lesions.* In pharmacy it is used for suspending resinous and oleaginous drugs in water; it also enters into the official emulsion of chloroform and into most of the official troches.

GLYCYRRHIZA—U. S. P.

(Licorice Root.)

Glycyrrhiza in the *root* of *Glycyrrhiza glabra*, or *Glycyrrhiza glandulifera*, a perennial herb growing in the countries lying on the northern and southern shores of the Mediterranean Sea; also cultivated in England and the United States. It contains a glucosid, *glycyrrhizin*, to which is due its sweetish taste; it also contains an acrid resin, starch and gum. The following preparations of licorice are official:

Fluidextractum Glycyrrhizæ, U. S. P. *Dose*, 15–60 min. (1.0–4.0 c.c.).
Extractum Glycyrrhizæ, U. S. P. *Dose*, freely.
Extractum Glycyrrhizæ Purum, U. S. P. *Dose*, freely.
Mistura Glycyrrhizæ Composita, U. S. P. *Dose*, 1–4 fl. dr. (4.0–16.0 c.c.).
Pulvis Glycyrrhizæ Compositus, U. S. P. *Dose*, 1/2–2 dr. (2.0–8.0 gm.).
Trochisci Glycyrrhizæ et Opii, U. S. P. (each contains 1/12 gr. —0.005 gm.—Powdered Opium).
Glycyrrhizinum Ammoniatum, U. S. P.

Physiologic Action and Therapeutics.—Licorice root is demulcent and slightly laxative, and when chewed increases the flow of saliva. It slightly stimulates and favors the secretion of mucus in the respiratory passages. It is a popular remedy for *cough, sore throat,* and *hoarseness.* It is found in many of the pharmaceutic preparations, and may be used to advantage in masking the taste of nauseating drugs. The official fluid extract and extract, and the syrup (N. F.) are largely used for this latter purpose.

ALTHÆA—U. S. P.

(Marshmallow.)

Marshmallow is the *dried root* of *Althæa officinalis,* a perennial herb growing in most countries with a temperate climate. Its chief constituents are mucilage, sugar, and starch.

Physiologic Action and Therapeutics.—Marshmallow is emollient, demulcent, and protective, and may be employed as such in all *irritable* and *inflamed conditions* of the mucous membrane and skin.

SASSAFRAS MEDULLA—U. S. P.

(Sassafras Pith.)

Official **sassafras** is the *dried pith* obtained from the branches of *Sassafras variifolium,* a tree indigenous to North America. The official preparation is:

Mucilago Sassafras Medullæ, U. S. P.

Physiologic Action and Therapeutics.—Mucilage of sassafras pith is a pleasant demulcent, and may be used wherever such is indicated. An infusion or tea made from the bark of the root of the sassafras tree has long been a domestic remedy as a "spring tonic."

ULMUS—U. S. P.

(Slippery Elm.)

Slippery elm is the *dried inner bark* of *Ulmus fulva,* a large tree growing in the United States and Canada. It contains much mucilaginous matter. The official preparation is:

Mucilago Ulmi, U. S. P. *Dose,* freely.

Physiologic Action and Therapeutics.—The mucilage of elm is a decided demulcent, and is supposed to possess nutritive properties. It is pleasant to the taste, and generally does not disturb the stomach. It is especially useful after *washing out the stomach* for any purpose. In the form of troches (elm lozenges), it is useful as a soothing agent in *irritated* or *sore throat.*

COLLODIUM—U. S. P.

(Collodion.)

Collodion is a solution of pyroxylin, or gun cotton, 4, in ether 75, and alcohol 25 parts. It is a colorless, syrupy liquid, highly inflamma-

ble, and having a strong ethereal odor. The following preparations are official:

Collodium Flexile, U. S. P.
Collodium Stypticum, U. S. P. (Tannic Acid, 20 per cent.).
Collodium Cantharidatum, U. S. P. (Blistering Collodion; Cantharides, 60 per cent.).

Therapeutics.—When applied to the skin, collodion quickly dries and forms a thin film, which not only protects an exposed part, but produces slight compression. It therefore makes an excellent protective for *aseptic wounds, fissures*, and *punctures*. This agent affords an efficient means of securing neat antiseptic dressings on dentist's hands which may be *abraded* or *punctured* by instruments. The wound, if necessary, can be cauterized with phenol or silver nitrate, and then covered with an antiseptic powder like europhen or boric acid; this should be covered with absorbent cotton and the dressing retained with collodion. Thus treated, the wound is well protected and should heal by first intention. The flexible collodion cracks less readily than the plain collodion, and may be used if desired.

Styptic collodion applied to small wounds, like *cold-sores* on the lip, will check capillary oozing. Cantharidal or blistering collodion may be used as a counterirritant in *pericemental inflammations*, and *neuralgias*.

Gutta-perchæ (unofficial).—**Gutta-percha** is a *milky, concrete exudation,* occurring in several species of the gutta tree, which is indigenous to the Malay Archipelago, Sulu Islands, Java, and recently it was learned that the gutta trees grow abundantly in the Philippine Islands. When pure, gutta-percha has a specific coloring between pink and grayish-white. Single pieces are not adhesive at ordinary temperatures, but heated slightly and pressed together the pieces adhere and cannot be separated. Gutta-percha is insoluble in water and alcohol, but soluble in chloroform, eucalyptol, and cineol.

Therapeutics.—Gutta-percha dissolved in chloroform may be used as a protective for *small wounds*. It has also been employed as a means of retaining antiseptic and other dressings in the canals of teeth. For this purpose it does not exclude the bacteria-laden saliva, and should be discarded. The solution, known as *chloropercha,* has long been successfully used in moistening the dried canal previous to filling with a gutta-percha cone. The author suggests heating the white base-plate gutta-percha in eucalyptol compound (see p. 295), when a thick, creamy solution results, which becomes a soft solid when cold. This preparation is used in filling root-canals, as will be explained in

Practical Therapeutics. Cochran suggests making a saturated solution of thymol in eucalyptol, and after cutting the gutta-percha with chloroform mixing the two solutions, permitting the chloroform to evaporate when a soft solid results, which is used in filling root-canals.

TALCUM—U. S. P.

(Talc; Magnesium Silicate; Soapstone.)

Talc is a native hydrous *magnesium silicate*, and occurs in grayish-green masses with a waxy luster, or as a white or pale gray powder. It feels greasy to the touch, hence it is commonly called *soapstone*. The Pharmacopeia also recognizes a purified talc (Talcum Purificatum, U. S. P.), which is used in the preparation of essential oil waters.

Therapeutics.—Finely powdered talc is employed as a dusting powder in inflammatory diseases of the skin, such as *acute erythematous eczema*. A useful formula is: Pulverized talc, 4 dr. (16.0 gm.); zinc oxid, 3 dr. (12.0 gm.); boric acid, 1 dr. (4.0 gm.). This powder is also useful in *chafing*. Many of the commercial talcum powders contain talc and boric acid in varying proportions. Talc, or soapstone, is used in dentistry also to coat the model so that it will draw nicely from the moulding sand in making a metal die.

KAOLINUM—U. S. P.

(Fuller's Earth; Hydrated Aluminum Silicate.)

Kaolin is a native *aluminum silicate*, occurring as a soft, white, or yellowish-white powder, odorless, and having an earthy or clay-like taste. It is insoluble in water, but becomes unctuous when moist. It is a very pure clay, having the chemic formula, $H_2Al_2Si_2O_8.H_2O$. The official preparation is:

Cataplasma Kaolini, U. S. P.

Therapeutics.—The cataplasm is used as a poultice, applied hot, in *mild local infections* about the face and jaws. Kaolin is also used in dusting powders, and is a constituent of *porcelain body*. In pharmacy it is used in pills containing easily reduced drugs, like silver nitrate and potassium permanganate, which cannot be mixed with the ordinary pill excipients.

LYCOPODIUM—U. S. P.

Lycopodium is the *spores* of *Lycopodium clavatum* and other species of *Lycopodium*, mosses growing in nearly all temperate countries. It is a fine powder, pale yellow in color, very mobile, inodorous,

tasteless, floats upon water and not wetted by it, and burns quickly when thrown into a flame.

Therapeutics.—Lycopodium is employed in therapeutics as a protective. It possesses great absorbent power for oils, which, together with its dryness and lightness, renders it an excellent dusting-powder for superficial *ulcers, eczema,* etc. In dentistry it is also used, like soapstone, for coating models in making dies; and in pharmacy it is employed to prevent the adhesion of newly-made pills and suppositories.

In the discussion of drugs thus far, the author has endeavored to group them, as far as was possible, into local and general remedies. Those having been considered are employed largely in therapeutics for their *local effects* upon the skin and mucous membranes of the respiratory and alimentary passages. The consideration of the next group, *local anesthetics,* will naturally lead us into the discussion of *general anesthetics,* and from then on general remedies will be considered.

ANESTHETICS.

Anesthetics have been elsewhere defined as agents which temporarily destroy sensation. They are subdivided into two classes: 1. Those which produce *local anesthesia;* and 2. those which produce *general anesthesia.* By local anesthesia is meant the abolition of sensibility to *pain* in a part; general anesthesia means the abolition of all sensibility, including unconsciousness. In the administration of general anesthetics, the patient experiences a stage where they are *insensible to pain,* though not unconscious. This condition is known as *analgesia,* which means the absence of sensibility to pain. Agents which produce the condition, whether general anesthetics, like *nitrous oxid, chloroform* or *ether*, or other drugs, such as *opium*, the coal-tar derivatives—*antipyrin*, *acetanilid*, and *phenacetin*—the *bromids*, *chloral*, etc., are called *analgesics.* Closely associated with these drugs is the term *anodyne*, which means an agent that relieves *pain.* An anodyne effect presupposes the presence of pain, an analgesic effect does not; it simply means that pain cannot be experienced. Many drugs possess local anodyne properties, such as many *volatile oils*, *phenol*, *cresol*, etc.

LOCAL ANESTHETICS.

Local anesthetic agents may be conveniently subdivided into two classes, according to their mode of action by which the anesthetic effect of the drug is produced.

1. **Refrigerant.**—Those agents which produce a degree of *cold* by the abstraction of heat from the part to which they are applied, even to the point of freezing the tissue.

2. **Paralyzant.**—Those agents which, when applied locally, have a direct paralyzant action upon the sensory nerve terminals.

Refrigerant.	*Paralyzant.*
Ethyl Chlorid Spray.	Cocain.
Ether Spray.	Tropacocain.
Rhigolene Spray.	Eucain.
Ice.	Novocain.
	Chloretone.
	Orthoform.

ÆTHYLIS CHLORIDUM—U. S. P.

(Ethyl Chlorid; Kelene; C_2H_5Cl.)

Ethyl chlorid is prepared by the action of hydrochloric acid gas upon absolute ethyl alcohol, the hydroxyl radical in the latter being replaced by chlorin. It occurs as a colorless, extremely volatile liquid, having an odor resembling that of chloroform and a burning taste. The vapor is highly inflammable, *and it should not be used near a gas-flame or burning alcohol-lamp.*

Physiologic Action.—Applied locally by means of a spray, ethyl chlorid acts as a refrigerant local anesthetic, the tissues soon becoming white and superficially frozen from the abstraction of heat.

The drug may be inhaled from gauze or a specially devised inhaler which is adjusted to the face, when it acts as a general anesthetic. The anesthesia is usually accompanied by a fall of arterial pressure and a gradual decrease in the pulse-rate, due in all probability to a direct action upon the heart. The patient becomes anesthetized, as a rule, in from 1 to 3 minutes, and from 1–2 fl. dr. (4.0–8.0 c.c.) of the drug being required, depending upon the patient. Its action is rapid and unirritating to the mucous membrane of the respiratory passages; there is an absence of choking sensation or cyanosis; and but rarely does nausea or vomiting follow. The recovery is generally complete in from 2 to 5 minutes.

Therapeutics.—Ethyl chlorid is usually sold in small metallic or glass tubes, provided with a lever-spring or screw top. When the lever is depressed or the screw released, the liquid is expelled as a spray by the heat of the hand. This drug is a safe and convenient local anesthetic for *minor operations* requiring but a single incision, as in the lancing of *abscesses, boils*, etc., or for the *extraction of loose teeth.* Its

local anesthetic action is not sufficiently profound to permit the painless extraction of firmly attached teeth. There is very little danger attending the local use of the drug from inhalation.

The drug may be used as a general anesthetic for *minor surgical operations* necessitating the administration of a general anesthetic. Ethyl chlorid is a constituent of many commercial products sold for general anesthetic purposes, among which may be mentioned *somnoform, narcotile,* etc.

As a general anesthetic, ethyl chlorid has the one advantage over nitrous oxid, or nitrous oxid and oxygen, in not requiring the cumbersome apparatus for its administration, but its safety as such cannot be compared with nitrous oxid. Though the drug has only been used a few years as a general anesthetic, quite a number of deaths from its use have been reported.

Ether Spray.—Ether, or ether and alcohol, in the form of a spray has been suggested as a means of *desensitizing dentin.* It acts as a refrigerant local anesthetic.

Rhigolene Spray.—Rhigolene is an unofficial distillate of petroleum. It may be used as a spray for the same purpose as ether, but has no advantages over the latter.

Ice.—Ice, or the ice and salt mixture, was probably the first of all local anesthetics. Though its use is largely superseded, especially in the mouth, by the volatile liquids, like ether and ethyl chlorid, it still has a place of usefulness upon accessible surfaces.

An ice-poultice may be made by sewing up tightly in rubber cloth crushed ice mixed with salt, and sawdust, bran, or ground flaxseed. Local applications of cold in this manner abstract heat from the part, lessen the sensibility of the peripheral nerve-filaments, cause constriction of the blood-vessels traversing the tissues exposed to the cold, and by reflex action affect the vascularity of the parts subjacent to the site of application.

COCA—U. S. P.

Coca is the *dried leaves* of *Erythroxylon coca,* a plant growing in the mountainous regions of Peru, Bolivia, and other South American states. It contains a number of alkaloids, the most important being *cocain,* which is official both as the alkaloid and alkaloidal salt under the titles, respectively, *Cocaina* and *Cocainæ Hydrochloridum.*

The general rule adopted by the United States Pharmacopeia in the nomenclature of articles of botanical origin is for the Latin title

to be the *genus* name of the plant and not the species. Coca, however, is a notable exception to this rule; for instead of calling this article Erythroxylon, it is officially designated Coca. While the early generic names of plants were selected rather arbitrarily, the differentiation of their species is almost invariably indicated in their specific names; yet some of the native plant names lead to great confusion. Students frequently confuse the names cocoa (cacao), coco (nut), and coca, three separate and distinct plants. When Von Humboldt discovered the chocolate nut he named it Theobroma (meaning God's drink) and cacao, after the native Indian name; but it has always been confused, because of the similarity of names, with the Cocos nucifera, the milk-bearing cocoanut; and by many to-day the oil of theobroma is called cocoa-butter instead of cacao. It should be remembered that *coca* is the official name for the plant, from the leaves of which that valuable alkaloid, *cocain* is obtained. The following preparations of coca are official:

Fluidextractum Cocae, U. S. P. *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Vinum Cocae, U. S. P. *Dose*, 2–4 fl. dr. (8.0–15.0 c.c.).

COCAINA—U. S. P.

(Cocain; $C_{17}H_{21}NO_4$.)

Cocain occurs in the form of colorless, prismatic crystals, having the bitter taste characteristic of all alkaloids, and producing on the tongue a temporary numbness. It is sparingly soluble in water (1–600 parts), much more so in alcohol (1–5 parts), more readily in both when warm, in ether (1–38), and in the oils (about 1–12). The average dose is about 1/2 gr. (0.030 gm.). There is one new official preparation:

Oleatum Cocainæ, U. S. P. (contains 5 per cent. of the alkaloid).

COCAINÆ HYDROCHLORIDUM—U. S. P.

(Cocain Hydrochlorid; $C_{17}H_{21}NO_4HCl$.)

Cocain hydrochlorid, called previous to the U. S. P. of 1900 cocain hydrochlorate, occurs in the form of colorless prisms, lustrous leaflets or flakes, or crystalline powder. This alkaloidal salt, like the alkaloid itself, has a bitter taste, and leaves a temporary numbness on the tongue. It is freely soluble in water (1–0.4 part), somewhat less so in alcohol (1–2.6 parts), and insoluble in ether and oils.

The amount to be injected hypodermically at one time should not exceed 1/4 to 1/2 gr. (0.016–0.03 gm.).

Brief History.—It may be stated as a matter of history that the introduction of cocain to the medical and dental world was due to Koller, of Vienna, who, in 1884, reported his experiments with the drug to the Congress of German Oculists. In a few weeks cocain or the alkaloidal salt, cocain hydrochlorid, was being used as a local anesthetic all over the world. Among the men whose names should be mentioned as early investigators are the following: Hepburn, Biggs, Hall, Halsted, Rudolph Metas, J. L. Corning, C. P. Pruyn, and others. Hall, in 1884, demonstrated by an experiment upon himself that he could inject solutions of cocain hydrochlorid into the infraorbital nerve and anesthetize the teeth. Halsted, in the following year, 1885, and some gentlemen in South America about the same time, not knowing that Halsted was working along the same line, demonstrated that they could inject 9 minims of a 4 per cent. solution into the inferior dental nerve as it entered the inferior dental canal, and produce complete anesthesia of the gums and teeth on that side of the jaw. It was about this time that Pruyn, of Chicago, conducted a long series of experiments on dogs, and to him much credit is due for the high place which cocain occupies in dental practice to-day. In speaking of these experiments, Pruyn[1] says: "The first dog that I experimented on, and subsequently killed, made me shudder to see the poor animal in the throes of death *fighting for his breath.* It made an impression on me that has lasted ever since, and taught me that cocain should be handled very carefully, particulary when we are using it upon the human subject." Therefore, the alarming symptoms and the frequent fatalities which followed the early use of cocain caused it for a time to be barred from general use in general and dental surgery. The fact, however, that many patients objected to general anesthetics on account of the unconsciousness induced, and the further fact that every conscientious surgeon recognized that a certain amount of danger always attends the administration of general anesthetics were sufficient to cause a few men to further experiment with the drug. They diminished the strength of the solution, and gradually mastered the technic of its administration until the alarming symptoms and frequent fatalities were largely overcome. So cocain stands to-day with scarcely a rival as a local anesthetic, notwithstanding the many attempts to displace the drug by the products of manufacturing chemists.

Physiologic Action.—Whatever effects result from the administration of preparations of coca are due entirely to the alkaloids contained therein. Cocain is a typical local anesthetic of the paralyzant

[1] Dental Review, Vol. 16, p. 312

group. When the drug enters the circulation its first action is that of a stimulant, followed shortly by a depressant effect. It is a general protoplasmic poison, and acts deleteriously upon all kinds of tissue. It has been supposed that the drug acts more prominently upon nerve tissue, but such is not the case. It is true that its action is more discernible upon nerve tissue for the reason that this tissue is the medium of sensation and expression. When applied locally or injected beneath the mucous membrane or skin, its depressant action on the sensory nerve filaments is sufficiently profound to induce complete local anesthesia or analgesia. It is also a powerful vasoconstrictor; the ischemia produced, however, is ultimately followed by congestion.

Long before the drug was used as a medicine, the natives of South America learned that by eating the leaves of the coca plant they could travel for days through the deserts without experiencing the sensation of hunger. We now know that the cocain paralyzed the nerve filaments which control the appetite.

Poisoning and Treatment.—The symptoms of *acute cocain poisoning* are rather variable. The usual train of symptoms are nervous excitement, followed by delirium, and later by drowsiness and stupor; nausea, vomiting, a rapid pulse, hurried and difficult respiration, dilatation of the pupils, cold sweat, blanched expression, blue lips, convulsive seizures, and finally death through asphyxia.

Individuals differ widely in their susceptibility to cocain. The local application of even moderate solutions of the drug to the nose or throat in some subjects is followed by toxic symptoms. Some have a peculiar idiosyncrasy for cocain. Cases have been authentically reported where the drug was not used, but where the patient supposed it had been, when they exhibited the usual toxic symptoms in mild form.

There is no known antidote for cocain; therefore, *the treatment of poisoning* is purely symptomatic. When the symptoms are rather mild the patient should be kept in a recumbent position, the head lower than the feet, if possible (the modern dental chair makes this possible), and such stimulants given as whisky, brandy, and aromatic spirit of ammonia, 15–20 minims (1.0–1.3 c.c.) of the latter in a small quantity of water. The irritation of the ammonia is what is desired, and it is best here not to dilute the drug too much. Spirit of ammonia or spirit of camphor may be given by inhalation. Ammonia irritates the mucous membrane, and thus indirectly stimulates the heart. When the symptoms are more pronounced, especially when the patient is unable to swallow and a direct cardiac stimulant is required, strych-

nin is the drug to administer. This may be given hypodermically in the form of strychnin sulphate, the injection being made in the arm or cellular tissue in the lumbar region. One-thirtieth grain (0.0025 gm.) may be administered at a time and repeated every 15 minutes, if occasion requires, until 3 injections are made. When there is danger of res-

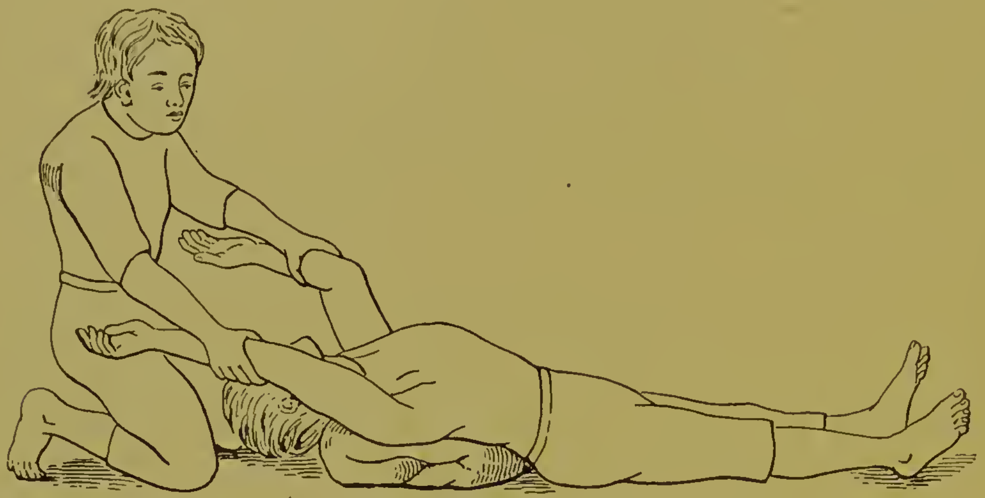

FIG. 1.—Artificial Respiration. First Movement.

piratory failure atropin sulphate in from 1/120–1/60 gr. (0.0005–0.001 gm.) should be given. As a last resort to prevent asphyxia, artificial respiration should be performed. *Sylvester's method* is the one most commonly employed. Figs. 1 and 2 show the position of patient and attendant.

FIG. 2.—Artificial Respiration. Second Movement.

With the patient placed on his back, on a flat surface, supporting the head and shoulders with a cushion or articles of dress, all tight clothing should be loosened or removed from the neck and chest.

The movements of inspiration and expiration should regularly succeed each other at the rate of from 20 to 25 respirations per minute, or

slightly in excess of the normal rate (about 18 per minute). The inspiratory period should be slightly longer than the expiratory. In all cases the artificial respiration should continue until natural respiration is established. This may require hours, and necessitate a relay of assistants. In the treatment of poisoning of any kind the operator should avoid the appearance of excitement, and remember that as long as there is life there is a chance of recovery.

Habit.—Cocain is one of the most seductive of the drugs that are taken habitually, and its effects are most disastrous. A potent cause of the cocain habit has been the frequent use of the drug in diseases of the nose and throat. As the drug is used in dentistry there is little chance of producing the habit; yet it is very unwise to prescribe the drug to be used by the patient at home in the form of toothache remedies, mouth-washes, gargles, or nasal sprays. The chief symptoms of the cocain habit are emotional excitement, physical unrest, mental impairment, a disregard for morals, hallucinations, gastric disturbances, a gradual wasting away, and anemia.

Therapeutics.—There is a demand by the laity for painless dentistry, and no one drug aids the dentist more in meeting this demand than cocain or its alkaloidal salt, cocain hydrochlorid. The drug is extensively used in the *painless extraction of teeth, lancing of abscesses*, the *removal of vital dental pulps*, and in many other places. Cocain hydrochlorid is recommended in cases of *nausea in taking impressions*. Goslee suggests using a 2 per cent. solution in an atomizer, spraying the entire palate and the uvula. A glass of tepid water should be at hand so the patient may rinse the mouth after a few seconds, to avoid swallowing the solution. The spraying process may be repeated about every five minutes until two or three applications have been made.

Cocain is also added to many arsenical preparations to control the irritating action of the arsenic trioxid. If the vehicle for such preparations is an oil, the alkaloid should always be used, as the alkaloidal salt is insoluble in oils.

The official oleate may be used to lessen the pain in setting crowns and bridges. This is done by applying the remedy under the margin of the gum a few minutes before setting the crown. Cocain hydrochlorid is used more extensively by the hypodermic method of administration for the painless extraction of teeth than for any other purpose in dentistry. A brief discussion, therefore, of the hypodermic use of the drug will here be considered.

Sodium chlorid has been recommended by Schleich and others

as an excellent agent to be added to local anesthetic solutions for two reasons: One is that it aids in the elimination of the drug, and the other, and more important, is that with it *isotonic solutions* can be prepared with local anesthetics as the base. The action of the so-called "salt solutions" will be discussed under Cathartics (which see, p. 204). Transitory anesthesia can be produced ultimately by pressure, or by simply injecting with force distilled water into the gum tissue; but distilled water being hypoisotonic to the normal fluids in the tissues, its injection causes a temporary swelling of the cells, due to osmotic action, and primary pain is produced. On the other hand, the injection of a hyperisotonic solution causes a temporary condensation of the cells, due also to osmosis, and primary pain is produced. If, therefore, isotonic solutions are employed for the purpose of inducing local anesthesia, osmotic action is avoided, and the relation of the cells to each other is not materially affected. Prinz suggests adding sodium chlorid in the following proportion in making an isotonic solution of cocain hydrochlorid:

Cocain Hydrochlorid,	5 grs. (0.3 gm.)
Sodium Chlorid,	4 grs. (0.25 gm.)
Distilled Water,	1 fl. oz. (30.0 c.c.)

To each syringeful (30 min.–2.0 c.c.) add one minim (0.065 c.c.) of a 1–1000 solution of adrenalin chlorid when used. The adrenalin solution should be fresh. The technic of making the injection has been fully discussed under the Hypodermic Method (p. 22).

The principal objections to the use of cocain hydrochlorid as a local anesthetic for hypodermic use are the *sloughing of tissue* so often induced, and the *liability to poisoning*. These are important considerations and will be discussed separately.

1. **Sloughing.**—It has been demonstrated quite conclusively that the aseptic injection of sterile isotonic solutions of cocain hydrochlorid will not result in sloughing. Therefore, sloughing is caused either by septic infection due to the injection or to the irritation produced by the disturbed relations of the cells from the injection of solutions which are not isotonic to the fluids in the tissues. It must be understood here that the latter cause mentioned would not result in sloughing of itself, but the irritation thus produced, together with the poisoning of the protoplasm of the cells by the cocain, so lowers the vital resistance of the affected tissues that infection is more liable to follow from external influences, especially where there has been laceration of tissue, as in extraction. Sloughing, therefore, is due en-

tirely to *septic infection*, either from the injection or from external influences. How to guard against septic infection has been previously considered.

2. **Poisoning.**—Poisoning by cocain hydrochlorid is due either to the injection of an *overdose* or to *idiosyncrasy*. As has been elsewhere stated, individuals differ widely in their susceptibility to cocain. In the manner of its action, as has been previously stated, cocain is a peculiar drug. Its action differs with different individuals, and with the same individual at different times. There is no way of foretelling how the drug is going to affect the patient in a given case. For this reason many physicians and dentists are afraid to use the drug. However, if we master the technic of its administration and *always know the quantity injected*, there is no necessity for fright, even though toxic symptoms develop, providing, of course, that an overdose has not been injected. It is practically agreed by the best authorities that the maximum quantity of cocain hydrochlorid to be permitted to enter the circulation at one time should not exceed one-quarter of a grain (0.016 gm.).

A great deal of the ill-results attributed to cocain is due to the carelessness with which the drug is used or to shock or fright on the part of the patient for which the drug is not at all responsible. Many times patients collapse from shock or faint from fear or dread of the operation; and, when cocain was used these results have frequently been attributed to the drug, when, as a matter of fact, the same result might have been and often is produced when no anesthetic had been used. Whenever cocain is used about the mouth for any purpose we should always have the patient rinse the mouth to prevent swallowing any of the remedy, for the smallest quantity of cocain in the stomach will often produce nausea.

Solutions of cocain hydrochlorid should be made at the time from soluble hypodermic tablets, or should contain antiseptics to keep the solution sterile. Phenol is an excellent agent to add for this purpose, and in from 1/2 to 1 per cent. it has no perceptible coagulant action on the albumin of the cells. Two per cent. of boric acid may also be added. The author's formula for hypodermic injection, which is practically isotonic, follows:

Cocain Hydrochlorid,	5 gr. (0.3 gm.)
Sodium Chlorid,	1 gr. (0.06 gm.)
Phenol (95 per cent.),	2 min. (0.13 c.c.)
Peppermint Water,	1 fl. oz. (30.0 c.c.)

It is well to add one minim (0.06 c.c.) of a fresh 1–1000 solution of adrenalin chlorid to 30 minims (2.0 c.c.) of the solution at the time of injection. It should be remembered that about 23 minims (1.5 c.c.) of this solution contains 1/4 grain (0.016 gm.) of the alkaloidal salt, the maximum quantity which may safely enter the circulation at one time. This does not mean that only 23 minims can be used at one injection; for a certain amount is lost in exhausting the air from the syringe, and a certain amount actually injected is removed before it enters the circulation, due to the subsequent hemorrhage. If the technic of injection has been mastered, one barrelful of the syringe should be amply sufficient to painlessly extract all of the teeth that should be extracted at one time, when any local anesthetic has been employed. Cocain should never be used without having at hand in a convenient and practical form the several antidotes for the drug.

There are many proprietary local anesthetic solutions on the market, and it is safe to say that cocain enters into most of them as the base of the formula. In this day of advanced dental therapeutics there is no necessity or excuse for using any proprietary remedy, the composition of which is unknown, especially when we are dealing with so powerful a drug as cocain.

Neurocain.—Neurocain is a name given to billets of cocain hydrochlorid, each containing 1/12 gr. (0.005 gm.), without excipient. The billets are 1/8 inch long, 1/20 inch in diameter, and very soluble in water. Cocain hydrochlorid is put up in this form expressly for dentists' use in the *removal of the pulp* by pressure anesthesia. They are convenient for this purpose, especially where it is desired to dissolve the local anesthetic in the serum of the blood in cases of *pulp exposure*. Similar preparations on the market are called *cocain points*.

Incompatibles.—Cocain hydrochlorid is incompatible with alkalies and alkaline carbonates and all alkaloidal reagents. The drug is decomposed by boiling water.

Tropacocain Hydrochlorid.—Tropacocain is an alkaloid obtained from the leaves of the Java coca plant. The hydrochlorid occurs as white needles, readily soluble in water. In its action it resembles cocain, but is less toxic and does not produce contraction of the blood-vessels. Its local anesthetic property is not sufficiently profound to merit employment as such in dental practice.

Ever since cocain has been used as a local anesthetic in dental and general surgery numerous attempts have been made by manufacturing chemists to prepare, synthetically, substitutes for the drug; among

which may be mentioned the following: The eucains, acoin, nirvanin, stovain, chloretone, and novocain. Many of these products were short-lived and failed to fill the place for which they were introduced, viz., to displace cocain as a local anesthetic. Those which proved to possess merit will here be discussed.

EUCAINA—Unofficial.

(Eucain; $C_{12}H_{12}NO_2(CH_3)_3$.)

Eucain is a synthetic product and was placed upon the market at first as "Alpha-eucain" and "Beta-eucain," two closely allied bases, differentiated as eucain "A" and eucain "B." The former has been withdrawn from the American market, while the latter is used quite extensively in dentistry as a local anesthetic in the form of *beta-eucain hydrochlorid.*

BETA-EUCAINÆ HYDROCHLORIDUM—Unofficial.

(Beta-eucain Hydrochlorid; Eucain Hydrochlorid *B*; $C_{12}H_{12}NO_2(CH_3)_3Cl$.)

Beta-eucain hydrochlorid occurs as a white crystalline powder, soluble in 20 to 30 parts of water at the ordinary temperature, more soluble in warm water, soluble in 25 to 30 parts of alcohol. The solutions are neutral and can be sterilized by boiling without change.

Physiologic Action and Therapeutics.—Eucain is a local anesthetic, like cocain, but weaker and devoid of the stimulating action of the latter. It does not dilate the pupil, and it differs from cocain in that it does not produce eschemia by the contraction of the blood vessels. By some this is claimed to be an advantage, as it permits more profuse hemorrhage after operating, and thus it is supposed some of the drug is carried out of the part and does not enter the circulation. The solutions of beta-eucain hydrochlorid have the one distinct advantage of being stable even on prolonged boiling. The drug may be used in almost all cases where cocain is indicated. A 2 per cent. solution being about the strength used for the *painless extraction of teeth.*

Incompatibles.—Alkalies and their carbonates and alkaloidal reagents.

NOVOCAINÆ HYDROCHLORIDUM—Unofficial.

(Novocain Hydrochlorid; $C_{13}H_{21}O_2N_2Cl$.)

Novocain hydrochlorid is a synthetic product, and occurs in colorless needle-shaped crystals, readily soluble in water (1 part) and

less soluble in alcohol (30 parts). The aqueous solutions of the salt are neutral and may be boiled without decomposition.

Physiologic Action and Therapeutics.—Novocain is claimed to be far less toxic than any of the synthetic substitutes for cocain. It is unirritating, but when injected beneath the skin or mucous membrane it exerts a prompt and powerful local anesthetic action. This effect, however, is not long sustained, but may be overcome by the simultaneous injection of the suprarenal alkaloid (adrenalin). To Prinz probably is due more than to any other one man the place which novocain occupies in dental practice to-day, especially in America. If combined with a fresh solution of adrenalin chlorid, the drug may be employed as a local anesthetic wherever cocain is indicated.

Incompatibles.—Novocain hydrochlorid is incompatible with alkalies and their carbonates and all alkaloidal reagents.

CHLORETONE.

(Chlorbutanol; $C_2Cl_3(CH_3)_2OH$.)

Chloretone is a synthetic product, and occurs as a white crystalline powder, with a camphoraceous odor and taste. It is sparingly soluble in water, but freely so in alcohol and ether. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—Chloretone, when first introduced, was claimed to have marked local anesthetic properties and was recommended as a substitute for cocain. The local anesthetic property, however, proved to be rather feeble. The drug may be classed as a local anodyne and antiseptic, and also acts when taken internally as a somnifacient. Its use in dentistry is largely that of an antiseptic, and it is added as a preservative of solutions of organic compounds, such as cocain and adrenalin.

ORTHOFORMUM—Unofficial.

(Orthoform; Methyl Meta-Amido-Para-Oxybenzoate; $C_8H_9O_3N$.)

Orthoform is a synthetic compound, and is the methyl ester of meta-amido-para-oxybenzoic acid. It occurs in a fine, white, or yellowish-white, crystalline powder, neutral in reaction, odorless and tasteless. It is practically insoluble in water, but soluble in 5 or 6 parts of alcohol and in 50 parts of ether. The dose is from 8–15 gr. (0.5–1.0 gm.).

Physiologic Action and Therapeutics.—Orthoform is a local anesthetic, and in its local action closely resembles cocain, but differs

from the latter in that it does not penetrate the tissue on account of its insolubility. It has practically no action on the unbroken skin or mucous membrane and produces no irritation except slight corrosion about the site to which it is applied. The drug is mildly antiseptic and practically nontoxic in the usual doses. As an anodyne remedy for *painful wounds or abraded surfaces* it is an absolute specific. Mawhinney suggests using equal parts of orthoform and europhen as a dusting powder for *burns, exposed alveolar process after extraction,* etc. It can be handled more conveniently in the mouth if a paste be made of the mixture of orthoform and europhen, using liquid petroleum as the vehicle. Plain aseptic gauze may be saturated with this paste and carefully packed into *painful sockets after extraction,* covering the exposed process and lacerated tissue with the oleaginous paste. The same packing is excellent after *root amputation* and other *minor operations* about the jaws.

Incompatibles.—Orthoform is decomposed by boiling water, and incompatible with alkalies and their carbonates.

GENERAL ANESTHETICS.

The detail technic of the administration of **general anesthetics** is a topic of sufficiently great importance as to merit discussion in a separate volume by specialists in this line of work. Several excellent books covering this phase of general anesthetics are on the market.

In our discussion of the drugs grouped under this heading, the author will confine himself largely to materia medica proper. The description of the drugs, their general action, and the indication or contraindication for their use are subjects which should naturally be considered in a work of this kind. The most important general anesthetics are:

Nitrous Oxid.
Ether.
Chloroform.
Ethyl Chlorid.*
Ethyl Bromid.

NITROUS OXID.

(Nitrogen Monoxid; Laughing Gas; N_2O.)

Nitrous oxid is a gas prepared by carefully heating, in a proper apparatus, ammonium nitrate. The gas is collected over water and purified by running it through a series of wash-bottles. It is colorless, odorless, and possessing a somewhat sweetish taste. By cold and

pressure it is converted into a liquid, when it is usually placed in iron cylinders and kept for subsequent use. When the gas is administered many times daily, as with extraction specialists, it is best to manufacture the gas fresh each morning and store it in an ordinary gas tank for this purpose.

Physiologic Action.—Nitrous oxid is the safest known general anesthetic. It is nonirritating when inhaled, but produces an increase of blood-pressure, a sense of exhilaration, ringing in the ears, and lividity of the face; in about one minute, if the gas is undiluted with oxygen, these symptoms are followed by complete unconsciousness. The muscles are not fully relaxed, and the conduct of the patient while under the influence of the gas depends largely upon the confidence the patient reposes in the anesthetist. Excitement, laughing, crying, a pugilistic tendency, though all done unconsciously, are often indulged in. It is claimed that the anesthesia is induced by a twofold action: the temporary displacement of oxygen from the blood, and the direct action of the gas on the cerebrum. The recovery is almost instantaneous upon the removal of the anesthetic agent. When the gas is mixed with air or pure oxygen the excitement is apt to be greater and the anesthetic effect more slowly produced.

Therapeutics.—Nitrous oxid is the ideal general anesthetic for all *minor surgical operations.* Indeed, the gas mixed in proper proportions with pure oxygen is fast gaining a reputation for operations in *major surgery.* By this means the patient may be kept under the influence of the anesthetic for hours. Much credit is due Teter, of Cleveland, Bevan, and Ream, of Chicago, and others, for developing the technic and encouraging the use of prolonged anesthesia by nitrous oxid and oxygen.

Many dental operations, like the *preparation of cavities in sensitive teeth, opening abscesses, removing partially decalcified pulp tissue,* etc., may be performed absolutely without pain under the influence of nitrous oxid, carried to the analgesic stage.

ÆTHER—U. S. P.

(Ether; Ethyl Oxid; $(C_2H_5)_2O$.)

Ether is made by the action of sulphuric acid on ethyl alcohol. It is a transparent, colorless, mobile, and very volatile liquid, having a characteristic odor and a burning, sweetish taste. Freely soluble in alcohol, chloroform, oils, and in about ten times its volume of water. Ether is highly inflammable, its vapor, when mixed with air and ignited,

explodes violently. It should be kept in well-stoppered containers, preferably in tin cans, in a cool place, away from lights or fire. The official product contains about 4 per cent. of alcohol. The dose is 15 min. (1.0 c.c.); for anesthesia about 1 fl. oz. (30.0 c.c.) The following preparations are official:

Spiritus Ætheris, U. S. P. *Dose*, about 1 fl. dr. (4.0 c.c.).
Spiritus Ætheris Compositus, U. S. P. (Hoffmann's Anodyne). *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).

Physiologic Action.—When applied to the skin, mucous membrane, or tooth-structure, ether produces intense cold by its rapid evaporation, and acts as a refrigerant local anesthetic. If it is confined on soft tissue, great irritation results. When inhaled as a general anesthetic, it irritates the mucous membrane of the respiratory tract, and at first coughing, choking, and a sense of strangulation follow. These symptoms are soon overcome, and complete loss of consciousness marks the subsequent stage of anesthesia, when total relaxation supervenes, accompanied by gentle, regular breathing. The drug is eliminated chiefly by the lungs and kidneys; on the latter organs it has an irritant effect, therefore it should be employed cautiously as a general anesthetic in cases of nephritis.

Therapeutics.—Ether is used largely as a general anesthetic, and, when thus administered for dental purposes, it had better be given by an experienced anesthetist. The ether spray is used for *obtunding sensitive dentin.* This requires a specially designed apparatus. Good results can also be immediately obtained by adjusting the rubber dam and evaporating the following remedy, applied to the cavity on a small pledget of cotton: Cocain, 20 gr. (1.3 gm.); chloroform, 2 fl. dr. (8.0 c.c.).; ether, 6 fl.dr. (24.0 c.c.). Ether is a valuable solvent for many substances insoluble in water, such as resins and oils.

The spray may also be used as a local anesthetic, preliminary to opening *abscesses,* but it is inferior to ethyl chlorid for this purpose.

The compound spirit of ether may be mixed with an equal volume of camphorated tincture of opium (paregoric) and given in doses of 1 fl. dr. (4.0 c.c.) to check *diarrhea* in hot weather. The compound spirit of ether is a useful remedy as an antispasmodic in children with complications of first dentition.

Contraindications.—Ether is contraindicated as a general anesthetic in cases of advanced arteriosclerosis; tuberculosis with a tendency to hemorrhage; acute and chronic diseases of the kidneys; anemia, when the hemoglobin is less than 30 per cent.; diabetes,

especially when well established. Death from ether usually results from asphyxia.

CHLOROFORMUM—U. S. P.

(Chloroform; Methyl Trichlorid; $CHCl_3$.)

Chloroform is made for commercial purposes by the action of chlorin on alcohol. It is a heavy, clear, colorless, mobile, and diffusible liquid, having a characteristic odor and a burning taste. Soluble in about 200 times its volume of cold water, and in all proportions in alcohol, ether, and oils. It is not inflammable, but its heated vapor burns, emitting a green flame. It should be kept in amber-colored, glass-stoppered bottles, in a dark, cool place. The dose is from 5–30 min. (0.3–2.0 c.c.); for anesthesia, about 1/2 fl. oz. (15.0 c.c.). The following preparations are official:

Aqua Chloroformi, U. S. P. *Dose*, 1/2–2 fl. oz. (15.0–60.0 c.c.).
Spiritus Chloroformi, U. S. P. *Dose*, 20–60 min. (1.3–4.0 c.c.).
Linimentum Chloroformi, U. S. P. (externally).
Emulsum Chloroformi, U. S. P. *Dose*, 1/2–1 fl. oz. (15.0–30.0 c.c.).

Physiologic Action.—When applied to the skin or mucous membrane locally, chloroform produces a sense of coldness by its rapid evaporation. If confined, it causes redness and even vesication. When inhaled it produces general anesthesia; the phenomena observed may be grouped under three stages, and are described by Stevens[1] as follows: The first stage is characterized by excitement, muscular rigidity, and lessened sensibility (analgesia); the second by anesthesia and muscular relaxation; and the third by stertorous breathing, abolition of reflexes, profound narcosis, and absolute muscular relaxation.

The drug is eliminated practically unchanged through the lungs and kidneys, and while it irritates the latter organs, its deleterious effects are less pronounced, owing to the smaller quantity necessary to induce profound anesthesia.

Therapeutics.—Chloroform is a rapid and agreeable general anesthetic. It is far more dangerous than ether, the mortality being five times greater, and should never be administered as a general anesthetic except by, or in the presence of, an experienced anesthetist.

With the patient in the upright position, chloroform may be carried to the analgesic stage, and *sensitive cavities prepared, deciduous teeth extracted*, or *abscesses lanced*. Most authorities agree, however,

1 Modern Materia Medica and Therapeutics.

that the drug should not be inhaled by the patient unless in the recumbent position, and that the analgesic stage is the most dangerous. It is the safest practice to refrain from using the drug in this manner, except perhaps in special cases.

Chloroform is a constituent of many liniments used for counter-irritation in cases of *pericementitis* and *neualgia*. The drug itself may be confined, and redness and even vesication follow. It has long been used as a solvent for gutta-percha, forming a solution known as *chloropercha*, used in *filling root-canals*. Like ether, the agent is used also as a solvent for many otherwise insoluble substances.

The liniment of chloroform has been extensively used as a stimulating remedy in *muscular rheumatism, sprains*, and *bruises*.

Indications and Contraindications.—Chloroform, though more dangerous than ether, is to be preferred to the latter as a general anesthetic in all acute inflammatory diseases of the bronchi or lungs, advanced diseases of the blood-vessels, acute and chronic diseases of the kidneys. In the extraction of teeth ether is considered the safer anesthetic; chloroform being more apt to cause cardiac paralysis, reflexly by way of the superior or inferior dental nerve. Chloroform is contraindicated in all cardiac diseases, and if administered here must be done cautiously. Death from chloroform usually results from circulatory failure.

As has been stated, the drug is pleasant to inhale, and many individuals have the *chloroform habit*.

ÆTHYLIS BROMIDUM—Unofficial.

(Ethyl Bromid; Hydrobromic Ether; C_2H_5Br.)

Ethyl bromid is made by heating a mixture of ethyl alcohol, sulphuric acid, and potassium bromid. When pure, it occurs as a colorless, highly volatile liquid, having an odor resembling chloroform and a sweetish taste. It is inflammable, and on exposure to air it liberates bromin and hydrobromic acid and becomes unfit for use. It should be kept in dark amber-colored bottles, tightly stoppered. The dose as a general anesthetic is from 1–6 drams (4.0–24.0 c.c.), depending upon the age and condition of the patient.

Physiologic Action and Therapeutics.—As a general anesthetic, ethyl bromid somewhat resembles the action of chloroform. It acts more quickly, however, and is less depressing, and its effects less lasting. It may be used for *short operations*, but has nothing to recommend its employment over nitrous oxid, except it does not require a cumbersome apparatus for its administration.

Those drugs not included in this group, which possess general analgesic or anodyne properties, will be considered under other headings in the following pages.

ANTIPYRETICS.

Antipyretics, called also *febrifuges*, are drugs which reduce the body temperature when abnormally high. This group includes:

Coal-tar Derivatives:
- Antipyrin.
- Acetanilid.
- Phenacetin.

Cinchona, especially its alkaloid, Quinin.

ANTIPYRINA—U. S. P.

(Antipyrin; $C_6H_5(CH_3)_2C_3HN_2O$.)

Antipyrin is a coal-tar derivative, basic in character, obtained by the condensation of phenyl hydrazin with diacetic ether and methylization of the product. It occurs as a white, crystalline powder or scales, odorless, of a slightly bitter taste, freely soluble in water, alcohol, and chloroform. The dose is from 3–15 gr. (0.2–1.0 gm.).

Physiologic Action.—Antipyrin has no action on the unbroken skin. It first irritates and then blanches mucous membranes, resulting in an analgesic effect. It may be considered a mild antiseptic, and applied locally to abraded surfaces it contracts the blood-vessels and acts as a mild styptic. Internally administered, it reduces abnormally high temperatures, as in fevers, but has practically no action in health. The drug here dilates blood-vessels and increases perspiration, and thus the heat reduction is brought about. Antipyrin differs from other anilin derivatives (acetanilid) in that it has no appreciable action upon the blood itself, and in this respect it is a much safer analgesic.

Therapeutics.—Antipyrin is a comparatively safe and useful drug in all conditions, the treatment of which calls for the relief of pain. Some authorities place it next to opium as a general analgesic. The drug may be given in powdered form or in solution for the *relief of pain of a neuralgic character,* and whenever it is desirable to *lower temperature in fever.* As an antispasmodic, it is useful in the *childhood period of tooth-eruption,* in *whooping-cough,* etc. Here it may be taken in combination with a bromid. The following may be given in teaspoonful doses, further diluted with water, to a child three years old, varying the dose according to the age: Antipyrin, 45 gr. (3.0 gm.); sodium bromid, 1 1/2 dr. (6.0 gm.); glycerin, 1/2 fl. oz. (15.0 c.c.); pepper-

mint water, 2 1/2 fl. oz. (75.0 c.c.). In *capillary oozing after operations*, the drug may be applied locally in powdered form, or a 20 to 30 per cent. solution, which is less irritating.

Incompatibles.—Antipyrin is incompatible with tincture of iodin, mercuric and mercurous chlorid, the ferric salts in solution, phenol, chloral, beta-naphthol, sodium bicarbonate, sodium salicylate, orthoform, spirit of nitrous ether, and the salts of quinin and caffein. The wide range of incompatibles is due to the basic properties of the drug.

ACETANILIDUM—U. S. P.

(Acetanilid; Antifebrin; $C_6H_5NH.C_2H_3O$.)

Acetanilid is a coal-tar product, derived from anilin, an atom of hydrogen in the latter being replaced by the acetic acid radical. It cocurs as a white, shining, crystalline powder, without odor, of a faintly burning taste, sparingly soluble in water, freely in alcohol and chloroform, and somewhat less so in ether. The dose is from 2–10 gr. (0.13–0.65 gm.). There is one official preparation:

Pulvis Acetanilidi Compositus, U. S. P. (Compound Acetanilid Powder; Acetanilid, 70 parts; Caffein, 10 parts; Sodium Bicarbonate, 20 parts). *Dose*, 7 1/2 gr. (0.5 gm.).

Physiologic Action.—Like antipyrin, in moderate doses in health acetanilid has no perceptible effect. Internally administered in fever, the drug produces marked fall of temperature, due, in all probability, to its direct influence on the centers which regulate heat-production. Free perspiration frequently accompanies the fall of temperature. In large doses acetanilid acts as a cardiac depressant and induces blood-changes. The blood assumes a chocolate color, due to the production of methemoglobin. It is, therefore, not as safe an analgesic as antipyrin, though exerting a greater influence over the nerve centers which control pain. Applied locally to mucous membranes or abraded surfaces, the drug is nonirritating and exerts an analgesic effect by depressing the sensory nerve-endings.

Poisoning and Treatment.—The symptoms of poisoning by acetanilid are marked cyanosis, feeble breathing, pulse soft, slow, later rapid and weak, free perspiration, pupils dilated and ultimate collapse. In the *treatment of poisoning* the body temperature should be maintained by external heat and such cardiac and respiratory stimulants given as strychnin sulphate, ammonia, and atropin sulphate

In combating the cyanosed condition inhalations of pure oxygen and artificial respiration are important.

Therapeutics.—Acetanilid, judiciously employed, is a valuable drug for the relief of pain in many diseased dental conditions, such as *acute abscess, neuralgia, headache,* etc. It is always best to combine the drug with a stimulant to overcome the depressant effect of acetanilid upon the heart. In the official powder, caffein is added for this purpose. Harlan suggested a formula wherein whisky was added as the cardiac stimulant. It is: Acetanilid, 10 gr. (0.65 gm.); simple syrup, 1/2 fl. oz. (15.0 c.c.); whisky, 2 1/2 fl. oz. (75.0 c.c.). The compound powder, which can be obtained in tablets, is an excellent form in which to administer the drug.

The drug may be cautiously applied locally in powdered form in the treatment of *wounds, burns, ulcers,* or other *abraded surfaces,* but is far inferior, as a local analgesic, to orthoform.

ACETPHENETIDINUM—U. S. P.

(Acetphenetidin; Phenacetin; $C_6H_4OC_2H_5.NHC_2H_3O$.)

Acetphenetidin commonly called **phenacetin,** is a coal-tar product obtained by the action of glacial acetic acid on paraphenetidin (an anilin derivative), one atom of hydrogen in the latter being replaced by the acetic acid radical. It occurs as white, glistening, crystalline scales or fine powder, without odor or taste, sparingly soluble in water, but freely so in alcohol and glycerin. The dose is from 5–10 gr. (0.3–0.65 gm.).

Physiologic Action and Therapeutics.—Internally administered, phenacetin exerts a similar action to that produced by antipyrin and acetanilid, though all authorities claim that it is far less toxic than either of these drugs. Everything considered, it is the most satisfactory of all of the coal-tar antipyretics. Probably the only objection that may be offered to its use is that it is more expensive than antipyrin or acetanilid, but when its safety is considered even this possible objection is outweighed. It may be advantageously employed in all cases where the other coal-tar analgesics have been mentioned. A useful formula is the combination of phenacetin and codein sulphate in the proportion of 5 gr. (0.3 gm.) of the former to 1/2 gr. (0.03 gm.) of the latter for an adult dose.

Though the actions of antipyrin, acetanilid, and phenacetin are similar, frequently results are obtained by the use of one of the drugs where the others have failed.

CINCHONA—U. S. P.

(Peruvian Bark.)

Cinchona is the *dried bark* of *Cinchona calisaya, Cinchona ledgeriana, Cinchona officinalis,* and several other species of *Cinchona,* tall evergreen trees indigenous to South America, and now cultivated in Ceylon, Java, and Jamaica. The specimen should yield not less than 5 per cent. of total anhydrous cinchona alkaloids, of which there are several; the most important are *quinin, quinidin, cinchonin* and *cinchonidin.* It should also contain not less than 4 per cent. of anhydrous ether-soluble alkaloids. The following preparations are official:

Fluidextractum Cinchonæ, U. S. P. *Dose,* 1/2–1 fl. dr. (2.0–4.0 c.c.).
Tinctura Cinchonæ, U. S. P. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Tinctura Cinchonæ Compositæ, U. S. P. (Huxham's Tincture; Red Cinchona, 10; Bitter Orange Peel, 8; Serpentaria, 2). *Dose,* 1–4 fl. dr. (4.0–15.0 c.c.).

Several of the alkaloids and their salts are also official. They are:

Quinina, U. S. P. *Dose,* 1–10 gr. (0.06–0.65 gm.).
Quininæ Sulphas, U. S. P. *Dose,* 1–20 gr. (0.06–1.3 gm.).
Quininæ Bisulphas, U. S. P.
Quininæ Hydrochloridum, U. S. P. } *Dose,* 1–15 gr. (0.06–1.0 gm.).
Quininæ Hydrobromidum, U. S. P.
Quininæ Salicylas, U. S. P. *Dose,* 1–10 gr. (0.06–0.65 gm.).
Oleatum Quininæ, U. S. P. (25 per cent.). Externally.
Cinchoninæ Sulphas, U. S. P.
Cinchonidinæ Sulphas, U. S. P. } *Dose,* 1–20 gr. (0.06–1.3 gm.).

Inasmuch as quinin is the most important alkaloid of cinchona and represents largely its active properties, it will be the only constituent here described.

QUININA, U. S. P.

(Quinin.)

Quinin occurs as a white, flaky, amorphous or crystalline powder, odorless, and of an extremely bitter taste. It is practically insoluble in water, but is readily soluble in acidulated water, alcohol, and ether.

Physiologic Action.—Quinin acts differently upon different individuals. In large doses, and with some subjects in comparatively small doses, it causes a sense of fullness in the head, ringing in the ears, deafness, headache, and sometimes dimness of vision. This group

of symptoms is included in the term *cinchonism.* The drug is absorbed chiefly from the stomach, and its action augments the secretions from the salivary and gastrointestinal glands; it, therefore, may be considered a stomachic and tonic. Through the kidneys is the principal mode of elimination. Butler[1] states that quinin has a remarkable effect upon the constituents of the blood. The ameboid movements of the white blood-corpuscles are arrested, preventing them from migrating through the capillary walls in inflammation. Full doses of the drug also diminish the white blood-corpuscles, while the red corpuscles are proportionately increased. Quinin diminishes the metabolism of the body by lessening the oxygen-carrying power of the red blood-corpuscles. Though it is doubtful that quinin ever directly caused the death of a human being, idiosyncrasies are frequently encountered. Two or 3 gr. (0.13–0.2 gm.) have been known to produce intense cinchonism in some individuals, and quinin rashes are not uncommon. The drug also acts as an antiseptic and it is claimed to possess local anesthetic properties. Quinin and urea hydrochlorid is now being used as a local anesthetic. The reports vary as to its value.

Therapeutics.—Quinin has been used extensively as a domestic remedy for many ills, and most individuals know how the drug affects them. This will govern the dentist in regard to the dose to be administered in a given case. The drug is a specific for *malarial fever,* and may be given in cases of *neuralgias* associated with the teeth; especially is it indicated here in malarial regions and in the spring of the year when the climate is more or less damp. The author prefers quinin bisulphate, as it is more soluble. It should be given in gelatin capsules rather than in the dry, hard, pilular form, as the latter may pass through the stomach undissolved. The drug is a constituent of many bitter tonics. Quinin sulphate has been recommended for its tonic and antiseptic properties as a local application in *pyorrheal pockets.* The bitter taste of the drug makes its use here almost prohibitive.

HYPNOTICS.

Hypnotics, also called *somnifacients,* are agents which induce sleep. The chief hypnotics are:

Chloral Hydrate.	Paraldehyd.
Butyl-chloral Hydrate.	The Bromids.
Sulphonal.	Opium (and Alkaloids).

Trional.

[1] Text-Book of Materia Medica, Therapeutics and Pharmacology.

CHLORALUM HYDRATUM—U. S. P.

(Hydrated Chloral; Chloral; $C_2HCl_3O + H_2O$.)

Hydrated chloral is obtained by the union of a molecule of water with trichloraldehyd, commonly called chloral, the latter being prepared by the action of chlorin upon alcohol, whence the name *chlor-al.* Chloral hydrate is the official preparation and the only one used in dentistry or medicine. It occurs as colorless, transparent crystals, having an aromatic, penetrating odor, and a bitterish, caustic taste; freely soluble in water, alcohol, ether, and chloroform. It liquefies when triturated with an equal quantity of menthol, thymol, phenol, or camphor. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action.—Applied locally, chloral hydrate acts as an antiseptic, mild anesthetic and vesicant. Even when applied to the unbroken skin, it produces redness and sometimes vesication. Internally administered in therapeutic doses, the drug induces quiet sleep of a natural character. The chief action of chloral hydrate is upon the nervous system, the sleep being the result of the direct influence of the drug over the cerebral cells which lessens reflex activity by depressing the motor neurons of the spinal cord. The drug is eliminated principally by the kidneys.

Poisoning and Treatment.—The symptoms of *acute choral poisoning* are sleep, deepening into coma. The pulse is feeble, thready, and irregular; temperature subnormal; respiration slow, followed by rapid shallow breathing, and ultimate collapse. Death may result from either cardiac or respiratory paralysis. In the *treatment of poisoning* the temperature should be maintained or restored by artificial heat—warm blankets, hot bottles, etc. Cardiac and respiratory stimulants, like strychnin, ammonia, atropin, and digitalis should be employed. To prevent asphyxia, inhalations of pure oxygen and artificial respiration should be resorted to early.

Therapeutics.—The principal use of choral hydrate is to induce sleep in cases of *insomnia.* It is especially indicated when the sleeplessness results from overwork, excitement, fear, or dread. It should not be given continuously on account of the liability to form habit. As a hypnotic for insomnia resulting from pain, the drug is far inferior to opium. On account of the powerful depressant effect chloral hydrate exerts upon the motor neurons of the spinal cord, it is a valuable drug in the treatment of the various *convulsions* and *spasmodic disorders of childhood,* such as the *complications of temporary dentition, whooping-cough,* etc. Combined with potassium bromid it is considered one of

the best sedatives in the treatment of the *convulsions of tetanus* and *strychnin poisoning.*

Chloral camphor, a clear, syrupy liquid, can be made by triturating equal parts of chloral hydrate and camphor. This remedy may be used as an anodyne in cases of *pulpitis*, and in *neuralgia.*

Contraindications.—The drug is contraindicated in cases of marked cardiac and respiratory weakness.

Incompatibles.—Chloral hydrate is incompatible with alkalies and strong solutions of antipyrin.

Butyl-chloral Hydrate.—This product is produced by the action of chlorin on acetic aldehyd, hydrated by the addition of water. It occurs in white, pearly scales, having a pungent odor, and an acid, disagreeable taste. It is practically insoluble in water, but freely soluble in alcohol and glycerin. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—In its action, butyl-chloral hydrate resembles that of chloral hydrate, except it is less powerful as a hypnotic and more irritant to the stomach. Authorities claim that the fifth or trigeminal nerve is especially susceptible to the influence of butyl-chloral hydrate, and the drug has been extensively used in the treatment of *trifacial neuralgia* and *migraine.* The drug is best given in the form of capsules on account of its disagreeable taste.

Incompatibles.—Butyl-chloral hydrate is incompatible with alkalies.

SULPHONMETHANUM—U. S. P.

(Sulphonmethane; Sulphonal; $(CH_3)_2C(SO_2C_2H_5)_2$.)

Sulphonal is a synthetic product obtained by the oxidation of a mixture of ethyl hydrosulphid and acetone (a liquid resembling ethyl alcohol in its action). It occurs as a colorless, odorless, and nearly tasteless, crystalline powder; soluble in 360 parts of cold water, in 15 parts of boiling water, and in 65 parts of cold or 2 parts boiling alcohol. The drug is stable and is not affected by strong acids or alkalies. The dose is from 15–30 gr. (1.0–2.0 gm.).

Physiologic Action.—Sulphonal is a pure hypnotic, its action as such being intensified by combining it with morphin or codein. It has no depressant effect upon the heart, but, like chloral hydrate, it acts chiefly on the nervous system by depressing the cerebral cortex; its influence, however, is less than the latter drug and its action much slower, due to its insolubility in the gastric fluids. The hypnotic

effect of sulphonal may not be evidenced for several hours after the administration of the drug.

Poisoning and Treatment.—The symptoms of acute sulphonal poisoning are headache, vertigo, marked cyanosis, vomiting, diarrhea, respiration shallow, pulse feeble, unconsciousness and final collapse. Some individuals who become habitual takers of this class of drugs present irregular toxic symptoms, consisting of sleepiness and stupidity, loss of appetite and muscular weakness. With some papular eruptions are not uncommon. The *treatment of acute poisoning* consists in the discontinuance of the drug; the administration of saline cathartics, and cardiac and respiratory stimulants as indicated by the symptoms present.

Therapeutics.—Sulphonal is used internally as a hypnotic. It has no other effect, and is never used externally. In *insomnia*, caused by *nervous excitement*, *grief*, or *overwork*, it is a useful hypnotic. In insomnia due to pain, it is practically worthless, unless combined with the alkaloids of opium. Sulphonal should always be given in powder or capsules or hot whisky. The compressed tablets, unless crushed, should be avoided on account of the sparing solubility of the drug.

SULPHONETHYLMETHANUM—U. S. P.

(Sulphonethylmethan; Trional; $C_2H_5.CH_3.C(SO_2C_2H_5)_2$.)

Trional is a synthetic product containing three ethyl radicals, where sulphonal contains but two. It occurs in colorless, lustrous, odorless, and almost tasteless, crystalline scales; soluble in 195 parts of cold water, and freely soluble in hot water, alcohol and ether. The dose is from 15–30 gr. (1.0–2.0 gm.).

Physiologic Action and Therapeutics.—Trional closely resembles sulphonal in its action. Being more readily soluble, however, the drug acts more quickly and has a tendency to accumulate in the body. It is, therefore, more poisonous than sulphonal. It is best administered in a warm vehicle, such as milk, tea, or brandy. The treatment of poisoning does not differ from that of sulphonal.

PARALDEHYDUM—U. S. P.

(Paraldehyd; $C_6H_{12}O_3$.)

Paraldehyd is a synthetic product obtained by treating aldehyd with dilute sulphuric or nitric acid. It occurs as a colorless liquid, having a strong ethereal odor, and a burning, pungent taste. It is soluble in 8 parts of cold water, somewhat less so in hot water, and is

miscible in all proportions with alcohol, ether, chloroform, and the oils. The dose is from 1/2–1 fl. dr. (2.0–4.0 c.c.).

Physiologic Action and Therapeutics.—Paraldehyd resembles chloral hydrate in its action in that it depresses the brain and spinal cord. It differs from the latter, however, in that its depressant action upon the heart is not nearly so marked, though it causes a noticeable fall in arterial pressure. The drug is used only internally as a hypnotic, and as such it is safe and reliable. It has the great disadvantage of being difficult to mask its nauseating taste, and its disagreeable odor is imparted to the breath for some time after its administration. The symptoms of *poisoning* and the treatment of the same are similar to chloral hydrate. As a hypnotic in dental practice, chloral hydrate is far preferable to sulphonal, trional, or paraldehyd.

THE BROMIDS.

The **bromids** of certain metals, notably potassium, sodium, and ammonium, might well be discussed under different headings; but they are true *spinal cord depressants*, and when administered produce hypnotic influence; therefore, they will be considered here.

POTASSII BROMIDUM—U. S. P.

(Potassium Bromid; KBr.)

Potassium bromid is a salt which occurs in colorless, or white cubical crystals or granules, odorless, with a pungent, saline taste; soluble in about 1.5 parts of water and in 180 parts of alcohol. The dose is from 5–60 gr. (0.3–4.0 gm.).

Physiologic Action.—The chief action of potassium bromid is on the nervous system. It depresses both the cerebrum and spinal cord. The drug is rapidly absorbed from the stomach, it having been found in the urine fifteen minutes after its ingestion. Its elimination is somewhat slower than its absorption, and there is a tendency for the drug to accumulate in the body. The continued use of potassium bromid is followed by a group of symptoms, called *bromism*, chief among which are anemia, fetor of the breath, gastric disturbance, mental depression, failure of memory, abolition of sexual appetite, and muscular weakness. In the treatment of *acute poisoning*, eliminatives should be given (diuretics and cathartics), the administration of the drug should be withdrawn, and other symptoms treated as presented. No fatal case of poisoning by potassium bromid is on record.

Therapeutics.—Perhaps there is no drug which will control the

nervousness due solely to the *dread of the dental chair* better than potassium bromid. The drug is especially indicated in *nervousness* caused by *fear* or *dread*. In cases of highly nervous individuals the drug may be given in 10 gr. (0.6 gm.) dose, after meals and well diluted, one day previous to the time of the dental operation. On account of the nauseating taste the drug should be dissolved in some of the official syrups. The compound syrup of sarsaparilla is an excellent vehicle.

Potassium bromid is one of the best drugs to control the convulsions of *epilepsy*, and is often used to advantage in the *complications of temporary dentition*. The drug is irritating to the stomach, and should always be given after meals, well diluted. It may be combined with the antipyretic drugs with excellent results.

Incompatibles.—Potassium bromid is incompatible with acids and acid salts. Certain alkaloids are precipitated from neutral solutions by the drug.

SODII BROMIDUM—U .S. P.
(Sodium Bromid; NaBr.)

Sodium bromid is a salt which occurs in colorless, or white, cubical crystals or granules, odorless, and of a saline, bitter taste; soluble in 1.7 parts of water and in 12.5 parts of alcohol. The dose is from 10–60 gr. (0.6–4.0 gm.).

Physiologic Action and Therapeutics.—Sodium bromid closely resembles potassium bromid in its action. It is less irritant to the stomach and less depressant, due to the sodium *ion*. Because of this fact, it may be substituted to advantage for the potassium salt in certain cases in which a bromid is indicated. It should be given after meals, well diluted.

Incompatibles.—The same as protassium bromid.

AMMONII BROMIDUM—U. S. P.
(Ammonium Bromid; NH_4Br.)

Ammonium bromid is a salt which occurs in white crystals or as a yellowish-white powder, odorless, and having a disagreeable salty taste; soluble in 1.2 parts of water and in 12.5 parts of alcohol. The dose is from 10–60 gr. (0.6–4.0 gm.).

Physiologic Action and Therapeutics.—Ammonium bromid resembles potassium bromid in its action. Like the sodium salt, it is less irritant to the stomach and less depressant to the nervous

system. It may be substituted for potassium bromid in all cases calling for the administration of a bromid. It should be given after meals, well diluted.

Incompatibles.—The same as potassium bromid, also spirit of nitrous ether.

NARCOTICS.

Narcotics are agents which induce stupor, and are closely related to stimulants in that the first effect of their action is generally that of an excitant and stimulant to the higher brain, to the mind, and to all of the bodily functions; this stage of their action is followed by profound sleep characterized by increasing stupor, and, if the dose has been sufficient, the second stage is followed by a third, that of coma and insensibility (narcotism), and ultimate death due to paralysis of the centers which govern respiration and other functions of life. The chief narcotics are:

Opium (and Alkaloids).	Alcohol.
Hyoscyamus.	Ether.*
Scopola.	Chloroform.*
Cannabis Indica.	Chloral Hydrate.*

Tobacco.

OPIUM—U. S. P.

Opium is the *concrete milky exudation* (*juice*) obtained by incising the unripe capsules of *Papaver somniferum*, a poppy plant indigenous to western Asia and cultivated in Egypt, Persia, Asia Minor, and other countries. It appears in irregular cakes or lumps, having a dark brown color, a gummy consistence, a peculiar narcotic odor, and a bitter taste. With the possible exception of cinchona, opium contains more alkaloids than any other drug. The chief alkaloids, in the order of their therapeutic significance, are *morphin*, *codein*, *narcein*, *thebain*, *narcotin*, and *papaverin*. To be up to the official standard, opium, in its normal moist condition, should yield not less than 9 per cent. of crystallized morphin. The dose is from 1/2–2 gr. (0.03–0.13 gm.). The official preparations are:

Opii Pulvis, U. S. P. (should contain not less than 12 nor more than 12.5 per cent. of Crystallized Morphin). *Dose*, 1/4–2 gr. (0.016–0.13 gm.).

Opium Deodoratum, U. S. P. (Denarcotized Opium, 12–12.5 per cent. of Morphin). *Dose*, 1/2–2 gr. (0.03–0.13 gm.).

Opium Granulatum, U. S. P. (12–12.5 per cent. of Morphin). *Dose*, 1/2–2 gr. (0.03–0.13 gm.)

Pilulæ Opii, U. S. P. (1 gr.–0.06 gm. of Powdered Opium in each). *Dose*, 1–2 pills.
Extractum Opii, U. S. P. (20 per cent. of Morphin). *Dose*, 1/4–1 gr. (0.016–0.65 gm.).
Tinctura Opii, U. S. P. (Laudanum; 10 per cent.). *Dose*, 5–20 min. (0.3–1.3 c.c.).
Tinctura Opii Deodorati, U. S. P. (10 per cent.). *Dose*, 5–20 min. (0.3–1.3 c.c.).
Tinctura Opii Camphorata, U. S. P. (Paregoric; contains Camphor, Benzoic Acid, Oil of Anise, and Powdered Opium; 4 fl. dr. (15.0 c.c.) represents about 1 gr. (0.065 gm.) of Opium). *Dose*, 1/2–4 fl. dr. (2.0–15.0 c.c.).
Tinctura Ipecacuanhæ et Opii, U. S. P. *Dose*, 5–15 min. (0.3–1.0 c.c.).
Acetum Opii, U. S. P. (10 per cent.). *Dose*, 5–20 min. (0.3–1.3 c.c.).
Vinum Opii, U. S. P. (10 per cent.). *Dose*, 5–20 m. (0.3–1.3 c.c.).
Pulvis Ipecacuanhæ et Opii, U. S. P. (Dover's Powder; contains 10 per cent. of Powdered Opium; 10 per cent. of Powdered Ipecac; and 80 per cent. of Sugar of Milk). *Dose*, 5–10 gr. (0.3–0.65 gm.).
Trochisci Glycyrrhizæ et Opii, U. S. P. (each contains 1/12 gr.–0.005 gm. of Powdered Opium). *Dose*, 1–5 tablets.
Emplastrum Opii, U. S. P. (6 per cent. of Extract of Opium). Externally.

Morphin and **codein** are the chief alkaloids of opium, and they represent the physiologic activity of the drug. Both are official. Morphin occurs in white prismatic, shining crystals or fine needles, odorless, of a bitter taste, and sparingly soluble in water, freely so in alcohol. The dose is from 1/8–1/2 gr. (0.008–0.032 gm.).

Codein occurs in white or nearly translucent prisms, or a crystalline powder, odorless, and having a faintly bitter taste; soluble in 88 parts of water and in 1.6 parts of alcohol. The dose is from 1/2–2 gr. (0.03–0.13 gm.).

The salts of morphin and codein are much more soluble than the alkaloids themselves, and these are generally prescribed. The following are official:

Morphinæ Acetas, U. S. P. *Dose*, 1/8–1/2 gr. (0.008–0.032 gm.).
Morphinæ Hydrochloridum, U. S. P. *Dose*, 1/8–1/2 gr. (0.008–0.032 gm.).
Morphinæ Sulphas, U. S. P. *Dose*, 1/8–1/2 gr. (0.008 0.032 gm.).

Pulvis Morphinæ Compositus, U. S. P. (Tully's Powder; contains Licorice, Camphor, Calcium Carbonate, and Morphin Sulphate). *Dose*, 5–10 gr. (0.3–0.65 gm.).
Codeinæ Sulphas, U. S. P. *Dose*, 1/2–2 gr. (0.03–0.13 gm.).
Codeinæ Phosphas, U. S. P. *Dose*, 1/2–2 gr. (0.03–0.13 gm.).

Physiologic Action.—Opium is a narcotic inducing stupor, and as a result true analgesic and hypnotic effects are produced. The dominant action being due to the morphin which it contains. The drug acts principally upon the brain, which it soon depresses, causing sleep. When the dose has been moderate, a stage of excitement or exhilaration generally precedes the narcosis. In large doses opium is a powerful respiratory depressant, and in fatal cases of poisoning death usually results from paralysis of the respiratory centers.

All of the secretions, except the perspiration, are diminished by opium; the salivary glands are especially affected, causing great dryness in the mouth and consequent thirst; digestion is also impaired and constipation results.

There is a difference of opinion in regard to the local action of morphin. Stevens[1] states that morphin, applied locally, acts as a direct depressant to the sensory nerve filaments. Many pharmacologists claim that the alkaloid has little or no local action, and that to produce its effect it must enter the circulation and be carried to the brain where it depresses the central nervous system.

Opium is rapidly absorbed and is eliminated chiefly from the viscera of the stomach and intestines (gastrointestinal mucous membrane) and very little by the kidneys.

Conditions and Drugs Modifying the Action of Opium.—There are certain symptoms, diseases, and drugs which greatly modify the action of opium. Patients suffering from severe pain, such as in acute alveolar abscess, neuralgia, etc., or patients having diabetes can frequently take with advantage doses which, under ordinary circumstances, would produce profound narcosis. The age and sex also modify the action of opium. Children are peculiarly susceptible to the drug on account of their sensitive nervous mechanism, and, therefore, smaller doses must be given than the age would naturally indicate. The action of opium is more pronounced on women than on men.

Patients rapidly acquire a tolerance of the drug through frequent repetition of the dose, so that habitues can often take large quantities without experiencing the usual effects.

[1] Modern Materia Medica and Therapeutics.

The hypnotic action of opium is enhanced by combining it with hypnotic drugs; its anodyne influence is increased by belladonna and cocain, and its diaphoretic effects by ipecac.

Poisoning and Treatment.—It is the acute rather than the chronic poisoning by opium with which the dentist should be familiar. Unless the dose is very large, the narcotic symptoms are manifested by three distinct stages. The first is excitement or exhilaration, in which the imagination is stimulated and the feelings are exhalted. This is soon followed by the second stage in which listlessness and drowsiness are the prominent symptoms, the patient finally falling into a deep sleep; the pulse is slow and full, the pupils are contracted to a pin-point size, the respirations are slow and difficult, the muscles are relaxed, and the face is pale. In this stage it is still possible to arouse the patient by loud noises, shaking, etc. From this stage, unless proper treatment be given, the patient gradually passes into the third, that of absolute coma and insensibility—a sleep from which they never awake, death finally resulting from paralysis of the respiratory and other life-centers.

The author well remembers his first experience in poisoning a cat with opium in the pharmacy course of instruction. A moderate dose of morphin sulphate was hypodermically administered. In a few minutes the animal imagined it had caught a mouse and was happy playing with it; after a short time, it became drowsy and fell asleep—here the pupils were contracted, respiration was slow and labored, and the muscles completely relaxed; finally, perhaps a half-hour from the time the first symptoms were manifested, the cat passed into that comatose state from which it never awoke.

In the treatment of *acute opium poisoning,* at least three objects are of prime importance: to eliminate the poison, maintain respiration, and prevent failure of circulation. The first thing to do, then, is to empty the stomach either by means of the stomach-pump or stimulating emetics, as zinc sulphate or mustard flour, and evacuate the bowels. Strong black coffee may be given by the mouth or bowel; it promotes wakefulness and stimulates respiration. Atropin and strychnin may also be given. The best chemic antidote is potassium permanganate; 3–5 gr. (0.2–0.3 gm.) of this drug should be dissolved in a glassful of water and given at once, repeated in thirty minutes, if necessary. Tannic acid has also been recommended as a chemic antidote, but neither the morphin sulphate nor hydrochlorid is precipitated by it. Counterirritants, slapping, shouting in the ear, may arouse the patient from his lethargy. Continually walking the patient or anything to

keep him awake is indicated. When the third stage (narcotism) is approaching, artificial respiration by Sylvester's method or by a pump is imperative.

Therapeutics.—Opium, or its alkaloids, has practically but one use in dental practice and that is to *control or relieve pain.* It is the greatest analgesic known and may well be remembered as the great "pain killer." In allaying the severe pain of *fractures, malignant growths,* and *acute inflammations of serous membranes* this drug has no rival. Pain of moderate intensity may often be allayed by the ordinary antipyretic and hypnotic drugs; when it is severe and excruciating and the cause cannot be at once removed, it is a waste of time to experiment with other drugs when so potent an agent as opium is obtainable. In *neuralgias* and other forms of recurrent pain opium or morphin should be used only after all other measures have failed, and then with extreme caution, on account of the danger of forming the opium habit. No other drug, except perhaps alcohol, is more enticing, and its continued use more liable to form the drug-habit than opium. It is the safest for a dentist never to write a prescription for the drug. With a prescription the patient may be relieved from the pain for which the remedy was prescribed, but subsequently they might get the prescription refilled on the least provocation, and thus the habit be innocently formed. Dover's powder is a common and valuable remedy in *acute coryza.* It is also a most efficient diaphoretic, and may be used in dentistry *to abort an acute alveolar abscess.* In conditions where the pain is not so severe, codein sulphate may be advantageously combined with other hypnotic drugs, such as phenacetin, etc.

Morphin has been added to various formulas for *devitalizing the pulps* of teeth. But as the drug has been shown to possess little or no local action, its use here is practically valueless. Cocain being far preferable to control the irritating action of the divitalizing agent (arsenic trioxid).

Contraindications.—On account of the peculiar susceptibility of children to the drug, if avoidable, opium should not be given under five years of age. One minim (0.06 c.c.) of tincture of opium (laudanum) has caused the death of a child one day old, and a few minims of camphorated tincture of opium (paregoric) has proved fatal to an infant nine months old. The death of a nursing babe is even reported where the mother had taken a medicinal dose of laudanum. The drug is, therefore, contraindicated in pregnancy and nursing mothers.

HYOSCYAMUS—U. S. P.

(Henbane.)

Hyoscyamus is the *dried leaves* and *flowering tops* of *Hyoscyamus niger*, a plant growing in Europe, Asia, and North America. The specimen should be collected from plants of the second year's growth, and should yield, when assayed, not less than .08 per cent. of alkaloids, of which there are two—*hyoscyamin* and *hyoscin*. Both are official, the former in the form of a sulphate (Hyoscyaminæ Sulphas, U. S. P.) and the hydrobromid (Hyoscyaminæ Hydrobromidum, U. S. P.); the latter in the form of the hydrobromid (Hyoscinæ Hydrobromidum, U. S. P.). The dose of the leaves of hyoscyamus is from 5–15 gr. (0.3–1.0 gm). The dose of the salts of hyoscyamin is from 1/100–1/50 gr. (0.0006–0.0013 gm.). The dose of hyoscin hydrobromid is from 1/150–1/80 gr. (0.0004–0.00085 gm.). The following preparations of hyoscyamus are official:

Tinctura Hyoscyami, U. S. P. *Dose*, 10–60 min. (0.6–4.0 c.c.).
Fluidextractum Hyoscyami, U. S. P. *Dose*, 5–15 min. (0.3–1.0 c.c.).
Extractum Hyoscyami, U. S. P. *Dose*, 1/2–3 gr. (0.03–0.2 gm.).

Physiologic Action.—In therapeutic doses hyoscyamus resembles belladonna in its action, causing dilatation of the pupils, checks the salivary secretions, producing dryness of the throat, and quickens the pulse and respiration. Its narcotic action upon the brain is somewhat more profound than that of belladonna. The consensus of clinical experience seems to be, also, that hyoscyamin and atropin closely resemble each other in their action; with hyoscin the action is quite different, this drug being a distinct hypnotic in that it depresses rather than stimulates the respiratory center (cerebrum).

Therapeutics.—Neither hyoscyamus nor its alkaloids are extensively used in dentistry; belladonna and atropin answering all of the purposes for which the former drugs could be employed. In *neuralgia* in individuals where a tonic is indicated or in malarial regions, the following remedy made into 12 pills or capsules, one given before meals, will prove beneficial:

Quinin Valerianate, 24 gr. (1.5 gm.).
Extract of Hyoscyamus, 4 gr. (0.25 gm.).
Extract of Cinchona, 8 gr. (0.5 gm.).

SCOPOLA—U. S. P.

Scopola is the *dried rhizome* of *Scopola carniolica*, a perennial plant growing in southern Europe. It is closely related to bella-

donna and hyoscyamus. It contains several alkaloids, the principal one being *scopolamin* which is chemically identical with hyoscin, and is official in the form of the hydrobromid (Scopolaminæ Hydrobromidum, U. S. P.). The dose of scopola is about 1/2 gr. (0.03 gm.). The dose of the alkaloidal salt is from 1/150–1/80 gr. (0.0004–0.00085 gm.). The following preparations are official:

Fluidextractum Scopolæ, U. S. P. *Dose*, 1–3 min. (0.06–0.2 c.c.).
Extractum Scopolæ, U. S. P. *Dose*, 1/8–1/4 gr. (0.008–0.016 gm.).

Physiologic Action and Therapeutics.—Scopola closely resembles hyoscyamus in its action as well as in the alkaloids which it contains, and may be used for practically the same purposes. Scopolamin hydrobromid and morphin sulphate in combination have been injected hypodermically previous to the administration of general anesthetics as a means of inducing a more *tranquil anesthesia.* By this means there is said to be the absence of mental excitement, bronchial irritation, and vomiting.

CANNABIS INDICA—U. S. P.
(Indian Hemp.)

Cannabis indica is the *dried flowering tops* of *Cannabis sativa*, a pistillate plant growing in the East Indies. It contains a natural resin called *cannabin*, and the specimen of the drug should be collected while the fruits are as yet undeveloped, for they then carry the whole of their resin. The dose is from 2–5 gr. (0.13–0.3 gm.). The official preparations are:

Tinctura Cannabis Indicæ, U. S. P. *Dose*, 5–20 min. (0.3–1.3 c.c.).
Fluidextractum Cannabis Indicæ, U. S. P. *Dose*, 2–5 min. (0.13–0.3 c.c.).
Extractum Cannabis Indicæ, U. S. P. *Dose*, 1/8–1 gr. (0.008–0.065 gm.).

Physiologic Action.—Internally administered in therapeutic doses, cannabis indica acts as a mild analgesic, hypnotic, and sedative. At first there is a marked stimulation of cerebral activities, the imagination is quickened and the flow of ideas heightened. There is generally a dreamy state accompanying these symptoms, and the sensation of pain and touch are blunted, as the centers governing these are affected. The excitement is finally followed by sleep which may last for several

hours. Although alarming symptoms often follow large doses of the drug, death directly attributable to it has not been reported.

Therapeutics.—Cannabis indica is employed for its mild analgesic action in certain forms of *neuralgia*, especially *migraine* and *headache*. It is extensively employed as a hypnotic in *melancholia*.

The extract should be given in pill or capsule, the tincture and fluid extract in alcoholic menstruum on account of the resinous constituent (cannabin) being precipitated by aqueous solutions. The drug is not employed for many of the disorders for which it was formerly used.

TABACUM—Unofficial.

(Tobacco.)

Tobacco is the commercial *dried leaves* of *Nicotiana tabacum*, an annual plant indigenous to tropical America, but cultivated in several parts of the world, especially in Virginia and Cuba. It contains a very poisonous, volatile, oily liquid alkaloid, called *nicotin*. The quantity of the alkaloid varies greatly in the different specimens, depending largely upon the climate and soil of the various countries in which it is raised. Cuba is supposed to produce about the best specimen of tobacco.

Physiologic Action and Therapeutics.—Tobacco is a marked depressant nauseant, it produces emesis by irritation as well as by systemic action. Its continued use by smoking or chewing it to excess, produces granular inflammation of the mucous membrane of the mouth and pharynx, atrophy of the retina, dyspepsia, lowered sexual vitality, sudden faints, nervous depression, and cardiac irritability. Used by the young, it hinders the development of the brain, and interferes with metabolism in general (Osler). It is claimed to produce cancer of the lips and tongue, blunting of the moral sense, mental aberration, and even insanity. The so-called "tobacco heart" induces many forms of nervous, painful, and oppressed cardiac action, depending upon the age, quantity used, and other conditions.

Nicotin is one of the most deadly poisons known. The author remembers poisoning a cat with this agent in the pharmacy school. The animal at once became greatly excited, then there was a wild stare, a deep sigh, and sudden death within three minutes after the ingestion of the drug. The claim that nicotin enters the body from smoking tobacco is without foundation, as the liquid alkaloid is volatile and the heat breaks it up into other compounds far less poisonous.

Chewing tobacco is supposed to allay *toothache* by many laymen. The claim is not justified from the physiologic action of the drug. Tobacco is not used therapeutically in dentistry.

STIMULANTS.

Stimulants are agents which increase the activity of life processes or functions. When the term stimulant is applied to medicinal agents it is used in various senses and is generally accompanied by such adjectives as cardiac, respiratory, gastric, restorative, etc., to indicate the various organs and processes of the body stimulated by the administration or application of the drug.

CARDIAC STIMULANTS.

These are agents which *increase the functional activity or the efficiency* of the heart's action. The chief cardiac stimulants are:

Nux Vomica (Strychnin).	Digitalis.
Alcohol.	The Nitrites.
Ammonia.	Camphor.
Caffein.	

NUX VOMICA—U. S. P.

Nux vomica is the *dried ripe seeds* of *Strychnos nux vomica,* a small tree growing in the East Indies. The drug contains two important alkaloids—*strychnin* and *brucin,* the former being in excess and fully represents the action of the crude drug which should contain, when assayed, not less than 1.25 per cent. of crystallized strychnin. Brucin resembles strychnin in its action, but is much less powerful. The dose of powdered nux vomica is from 1–5 gr. (0.06–0.3 gm.). The following preparations are official:

Tinctura Nucis Vomicæ, U. S. P. *Dose,* 5–20 min. (0.3–1.3 c.c.).
Fluidextractum Nucis Vomicæ, U. S. P. *Dose,* 1–5 min. (0.06–0.3 c.c.).
Extractum Nucis Vomicæ, U. S. P. *Dose,* 1/8–1/2 gr. (0.008–0.03 gm.).

As has been stated, strychnin fully represents the action of nux vomica. This alkaloid is official.

STRYCHNINA—U. S. P.

It occurs as colorless crystals or a white crystalline powder, odorless, and having an intensely bitter taste; sparingly soluble in water. Two salts of strychnin are official, the sulphate (Strychninæ

Sulphas, U. S. P.) and the nitrate (Strychninæ Nitras, U. S. P.). Both in appearance resemble the alkaloid itself, but are much more soluble in water. The dose of strychnin or of either of its salts is from 1/60–1/20 gr. (0.001–0.003 gm.).

Strychnin is a constituent of the following official preparations:

Glycerite of the Phosphates of Iron, Quinin, and Strychnin.
Syrup of the Phosphates of Iron, Quinin, and Strychnin.
Compound Syrup of Hypophosphites.
Compound Laxative Pills.
Elixir Iron, Quinin, and Strychnin, N. F.

Physiologic Action.—Strychnin is a true cardiac stimulant, the pulse becoming stronger and more rapid under its influence as a result of its action upon the heart and vasomotor center. The drug also acts as a powerful respiratory stimulant, the movements of respiration becoming deepened and quickened. The chief action of strychnin is upon the nervous system. Here it acts as a powerful stimulant to the spinal cord, especially the centers governing the movements of the body. The most marked effect of the drug, in toxic doses, is increased reflex irritability of the spinal cord, which is shown most conspicuously by the production of muscular rigidity. Nux vomica or strychnin, in small doses, strengthens the muscular movements of the stomach and increases the flow of gastric secretions. It therefore acts as a stomachic. The drug is eliminated principally through the kidneys.

Poisoning and Treatment.—If the dose of strychnin is within therapeutic limits, yet sufficient to produce slight toxic effects, the first symptom is likely to be a feeling of uneasiness with heightened reflex irritability, and this may be followed by muscular twitching in some part of the body. With larger doses, spinal convulsions result from the slightest external irritation, causing the patient to rest on his head and feet (opisthotonos); the flexor muscles are overcome by the extensors, and the feet are curved inward. The convulsions for the most part are intermittent; during the intermission there is complete muscular relaxation. During the attack the contraction of the facial muscles causes the patient to grin in a ghastly manner, but the muscles of the jaws are unaffected until toward the last. This latter diagnostic sign should be remembered, as strychnin poisoning may become confused with tetanus on account of the rigidity of the muscles during the convulsive attacks. In tetanus the muscles of the jaw are very early implicated. Other diagnostic marks of tetanus, as contrasted with it, are slower development of the symptoms and the continuous muscular rigidity. There is never complete muscular

relaxation even in the intermission of the spasms as there is in strychnin poisoning.

The number of convulsive seizures varies in different instances, but generally three or four are fatal; the patient succumbing to asphyxia and exhaustion. In the *treatment of strychnin poisoning*, if the patient is seen early enough, emetics, particularly apomorphin hydrochlorid (1/10 gr.–0.006 gm.) hypodermically, should be given, followed by washing out the stomach. If violent convulsions already are present, evacuation of the stomach, as a rule, is contraindicated, as either emetics or the stomach-pump would provoke further attacks. Inhalations of chloroform or amyl nitrite will control the spasms. As a chemic antidote tannic acid in solution may be administered. Probably the best physiologic antidotes are potassium bromid (1–2 dr.—4.0 –8.0 gm.) and chloral hydrate (20 gr.—1.3 gm.); when the patient is unable to swallow, the latter drug (1 dr.–4.0 gm.) may be given in an enema (per rectum). These agents depress the nerve centers stimulated by the strychnin. Since the slightest external stimulus will provoke convulsions, the patient should be disturbed as little as possible.

Therapeutics.—Nux vomica or strychnin is used chiefly as a cardiac stimulant, a respiratory stimulant, a motorexcitant, and a stomachic. Strychnin sulphate, in soluble tablet form of proper therapeutic dose (1/60 gr.–0.001 gm.), should be in every dental office. It being both a cardiac and respiratory stimulant makes it a valuable remedy in cases of *poisoning* by drugs which depress the cardiac and respiratory center. In poisoning by cocain, opium, chloral hydrate, aconite, ether, chloroform, or ethyl chlorid, it should be given hypodermically in full doses and repeated, if necessary in fifteen minutes. In *neuralgia* due to an atonic condition, strychnin is indicated. Here it may be given in either the elixir, syrup, or glycerite of the phosphates of iron, quinin, and strychnin.

Incompatibles.—Strychnin is incompatible with tannic acid, alkalies, and the salts of the halogen elements (Cl, I, and Br.).

ALCOHOL—U. S. P.

(Ethyl Alcohol; C_2H_5OH.)

Ethyl alcohol is obtained by the distillation of fermented saccharaceous substances. To be up to the official standard it must contain 92.3 per cent. by weight of absolute ethyl alcohol. It occurs as a colorless, transparent, mobile, and volatile liquid, having a pungent odor, and a burning taste; miscible with water, ether, and chloroform

in all proportions. It is inflammable and burns with a bluish, non-luminous flame.

The following preparations are official:

Alcohol Absolutum, U. S. P. (99 per cent. Alcohol).
Alcohol Dilutum, U. S. P. (41.5 per cent. by weight of Absolute Alcohol).
Spiritus Frumenti, U. S. P. (Whisky; 37 to 47.5 per cent. Alcohol, distilled from fermented grain).
Spiritus Vini Gallici, U. S. P. (Brandy; 39 to 47 per cent. Alcohol; distilled from fermented grapes).
Spiritus Juniperi Compositus, U. S. P. (equivalent to Gin; about 60 per cent. Alcohol).
Vinum Album, U. S. P. (White Wine; 7 to 12 per cent. Alcohol).
Vinum Rubrum, U. S. P. (Red Wine; 7 to 12 per cent. Alcohol).

The official wines are made by fermentation of pure grape juice.

The following unofficial preparations contain alcohol:

Rectified Spirit (85 per cent. by weight of Absolute Alcohol).
Proof Spirit (49 per cent. by weight of Absolute Alcohol, Volatile Oil, and other foreign material).
Gin (42 per cent. by weight of Absolute Alcohol, distilled in Holland from rye or barley, and flavored with juniper berries or hops).
Malted Liquors (Beer, Ale, and Porter) are prepared by fermenting malted grain with hops and adding other bitters. Beer contains 2 to 3 per cent. of Alcohol; ale and porter, from 4 to 6 per cent., besides carbonic and lactic acids, malt extract, various aromatics, and certain salts of sodium and potassium.

Physiologic Action.—There is much diversion of opinion regarding the physiologic action and uses of alcohol. Applied to the skin, it extracts water from the tissues and acts as a detergent and antiseptic. On the mucous membrane it extracts water with greater rapidity, coagulates albumin, and causes a whitened and corrugated surface. The gastric functions, as well as the flow of saliva, are reflexly stimulated by its local action in the mouth.

Internally administered, alcohol reflexly and rapidly stimulates the heart before absorption can take place, the effect upon the circulation persisting after the absorption of the drug. It depresses the vasoconstrictors; thus arterial tension is raised, though the arterioles are dilated. Toxic doses depress the heart's action, and still further dilate the peripheral blood-vessels. This action of alcohol, in causing the heart to beat stronger and faster, at the same time dilating the blood-vessels —especially those of the peripheries—renders the drug one of the most

valuable diffusible stimulants (Butler). The dominant action of alcohol is on the nervous system. It first stimulates and then paralyzes all parts of the nervous system.

Poisoning and Treatment.—The poisonous action of alcohol may be discussed as *acute* and *chronic alcoholism.*

Acute Intoxication.—The ingestion of large quantities of alcohol produce certain characteristic symptoms: Flushing of the face, mental excitement, a quickened pulse and respiration; in a short time the speech becomes incoherent, the pupils are dilated, then follows delirium, loss of cöordination, subnormal temperature, vomiting, loss of ability to control the acts of toilet, and, finally, stupor and coma. If the dose has not been too large, recovery follows in a day or two.

Stevens[1] emphasizes the care to be taken in order to distinguish acute alcoholism from uremia, opium poisoning, and apoplexy. The urinous odor of the breath, the small pupils, and the presence of albumin in the urine will serve to distinguish *uremia.* The small pupils, slow and labored respiration, and slow and full pulse will point to *opium poisoning.* The unequal pupils, hemiplegia, and high temperature will indicate *apoplexy.* In the *treatment of acute alcoholism* the stomach should be emptied of all unabsorbed alcohol by the stomach-pump, a stimulating emetic (mustard flour), or the hypodermic injection of apomorphin (1/10 gr.–0.006 gm.). Cautious inhalations of ammonia should be given, together with the internal administration of black coffee. The patient should be made to perspire freely by the application of external heat (warm blankets, etc.), and if there is danger of collapse, strychnin sulphate (1/30 gr.–0.002 gm.) should be hypodermically administered and artificial respiration practised.

Chronic alcoholism is generally the result of the continuous and excessive use of alcohol, and is characterized by disturbed sleep, fine tremor, mental impairment, gastric irritation, injection of the eyes, redness of the nose and cheeks, due to the permanent dilatation of the capillaries. A frequent complication of chronic alcoholism is *delirium tremens.* This condition is manifested by great mental excitement, insomnia, incoherent speech, tremors, and terrifying hallucinations of sight and hearing. In favorable cases recovery follows in a few days, but frequently symptoms of typhoid and pneumonia develop, and the attack ends in death. In the *treatment of delirium tremens* the main indications, according to Butler,[2] are:

[1] Modern Materia Medica and Therapeutics.
[2] Text-Book of Materia Medica, Therapeutics and Pharmacology.

1. *Elimination* by diaphoresis, catharsis, diuresis, warm baths, etc.

2. *Support.*—Some alcohol may be necessary. Easily digested food. Enemata, if necessary.

3. *Quiet.*—Hypnotics: opium, chloral hydrate, the bromids.

In the *treatment of chronic alcoholism* it is necessary to consider the character of the individual affected. Butler states that a thoughtful and extended experience with dipsomaniacs will convince most observers that the vast majority of them suffer from a disease possessing usually a distinct and traceable etiology, and resulting from either inherited or acquired neurosis. It is a condition akin to epilepsy; the treatment, therefore, turns on the discovery of the conditions preliminary to the drinking period and the determination whether this can be prevented by dietetic and therapeutic measures, as is done in cases of epilepsy.

The medicinal agents employed are strychnin, atropin, small doses of such alteratives as arsenic, potassium iodid, and mercury, while phosphorus and other restoratives and tonics will prove efficacious.

Therapeutics.—Alcohol is extensively used locally in dentistry as a dehydrator, detergent, and antiseptic. Its action upon bacteria is no doubt due to its power of abstracting water and of coagulating albumin. According to the experiments of pharmacologists, the most effective dilutions of alcohol against the strongly resisting (nonsporing) bacteria, such as the pus organisms, are those containing from 60 to 70 per cent. by volume.

For spraying the mouth previous to performing any dental operation, the author is very partial to cinnamon water to which from 2–5 per cent. of alcohol has been added. It should be remembered that alcohol is less valuable as a disinfectant than as an antiseptic and as a vehicle for stronger agents of this class; therefore, from 10 to 25 per cent. alcohol makes an excellent addition to aqueous antiseptic solutions. Absolute alcohol is frequently added to tooth-pastes for its antiseptic and solvent power. The drug is used as a styptic to check *capillary oozing*, and a very efficient means of reducing *temperature in fever* is to bathe the skin with alcohol; the method is also employed to check *excessive sweating*. Alcohol is a positive antidote for phenol, and whenever the latter agent is being used about the mouth, it should be in a convenient place to neutralize the caustic action of phenol, should the latter accidentally get on the soft tissues of the mouth. Alcohol is employed internally as a diffusible circulatory stimulant, a stomachic, a food, and a chemic antidote for phenol. In all forms of sudden heart-failure, as in *syncope*, *shock*, *snake-bite*, etc., it is an invaluable stimulant. Whisky or brandy should be in every dental office to

be used as a cardiac stimulant in cases of *cocain poisoning* or other conditions which depress the heart.

AMMONIA.

(NH_3.)

Ammonia is obtained as a by-product in the manufacture of coal-gas. It occurs as a colorless gas, having a very penetrating odor and an acrid taste. It is chemically soluble in water, and in chemistry it is considered a hypothetical metal, as it acts like a base in uniting with acids to form salts. The following preparations are official:

Aqua Ammoniæ Fortior, U. S. P. (Stronger Ammonia Water; 28 per cent. by weight of the Gas).
Aqua Ammoniæ, U. S. P. (Ammonia Water; 10 per cent. by weight of the Gas).
Spiritus Ammoniæ, U. S. P. (Spirit of Ammonia; 10 per cent. by weight of the Gas).
Spiritus Ammoniæ Aromaticus, U. S. P. (Aromatic Spirit of Ammonia; contains Ammonium Carbonate, 34; Ammonia Water, 90; Oil of Nutmeg, 1; Oil of Lemon, 10; Oil of Lavender Flowers, 1; Alcohol, 700; Water to make 1,000). *Dose*, 1/4 to 1 fl. dr. (1.0–4.0 c.c.).
Linimentum Ammoniæ, U. S. P. Externally.

Physiologic Action.—Ammonia has a decidedly irritant local action, and in concentrated solution it speedily produces vesication. The drug has the decided advantage of being a gas which permits of inhalation, and its irritant action upon the mucous membrane of the respiratory passages reflexly stimulates the cardiac and respiratory centers; both the strength and rapidity of the pulse and the depth and rapidity of the respirations are markedly increased. Given in weak solutions, the drug stimulates the flow of gastric juice, its action here resembling other alkalies. The gas acts upon the nervous system by stimulating the motor centers of the spinal cord, and thus reflex activity is increased.

Poisoning and Treatment.—In toxic doses preparations of ammonia are powerful corrosive poisons. The characteristic symptoms are severe burning pain in the fauces, esophagus, and stomach, with intense gastroenteritis. The violent irritation of the throat sometimes causes edema of the larynx, resulting in almost immediate death from asphyxia. In the *treatment of ammonia poisoning* the drug should be neutralized by some weak acid, like vinegar. This should be followed by demulcent drinks, opium being indicated for the relief of pain.

Therapeutics.—The chief use of ammonia in dental therapeutics is as a cardiac and respiratory stimulant. The drug acts quickly, and is an invaluable remedy in *syncope, collapse,* and other forms of *sudden heart failure.* When it is desired to give the drug by inhalation, as can easily be done on account of the volatility of the gas from its solutions, it is best to select the spirit of ammonia or ammonia water as the preparation to use. For internal administration the aromatic spirit of ammonia should be selected and given well diluted.

The liniment of ammonia is a popular counterirritant remedy in *chronic rheumatism, joint affections,* and *chilblains.*

Incompatibles.—Ammonia is incompatible with all acids, chloral hydrate, and alkaloids. With ferric salts it forms ferric hydroxid, which is an antidote for arsenic. With formaldehyd it forms urotropin.

AMMONII CARBONAS—U. S. P.

(Ammonium Carbonate; $NH_4HCO_3.NH_4NH_2CO_2$.)

The official **ammonium carbonate** is really a mixture of ammonium acid carbonate and ammonium carbamate. It occurs in white, internally translucent, crystalline masses, having an extremely pungent odor, and an acrid taste; soluble in 4 parts of water. The dose is from 5–10 gr. (0.3–0.6 gm.).

Physiologic Action and Therapeutics.—This drug is a cardiac and respiratory stimulant, due to the ammonia gas which is constantly liberated. It is also a stimulating expectorant. It enters into the composition of aromatic spirit of ammonia, which preparation is extensively used in dental therapeutics.

CAFFEINA—U. S. P.

(Caffein; $C_8H_{10}N_4O_2.H_2O$.)

Caffein is an alkaloid obtained from the *leaves* of *Thea sinensis* (tea), or from the *seeds* of *Coffea arabica* (coffee). It occurs in fine, colorless, silky crystals, without odor, and having a bitter taste; soluble in about 46 parts of cold water. The dose is from 2–5 gr. (0.13–0.3 gm.). The following preparations are official:

Caffeina Citrata, U. S. P. (Caffein Citrate). *Dose,* 2–5 gr. (0.13–0.3 gm.).

Caffeina Citrata Effervescens, U. S. P. *Dose,* 1–2 dr. (4.0–8.0 gm.).

Physiologic Action.—Caffein is a powerful cardiac and respiratory stimulant. Its action upon the circulatory system results in high blood-pressure and increased frequency of the pulse, due in part to its direct influence upon the heart and its stimulating action upon the vasomotor centers. The brain seems to be especially susceptible to the influence of caffein, small doses sharpen the intellect and produce wakefulness. The drug also acts as a diuretic, stimulating the secreting structure of the kidneys, and is quickly eliminated through these organs.

Therapeutics.—Caffein is an entirely safe drug to be used in large dose, hence it is one of the best stimulants to employ in *poisoning* by narcotic drugs, like cocain, opium, etc. Caffein citrate is the preparation generally used because it is more soluble than caffein. Strong black coffee is also used.

The drug is a constituent of compound acetanilid powder. Its action overcomes the depressant effect of acetanilid upon the heart. It may also be combined with phenacetin or a bromid and used with excellent results in *migraine* and *nervous headache.*

DIGITALIS—U. S. P.

(Foxglove.)

Digitalis is the *dried leaves* of *Digitalis purpurea,* a biennial plant growing in central and southern Europe. It contains several principles, all of which are glucosidal in character, the most important being *digitalin, digitoxin, digitalein, digitonin,* and *digitin.* The first two represent more or less imperfectly the action of digitalis upon the heart, and since both are freely soluble in alcohol and practically insoluble in water, it will at once be observed that the most active principles of the drug are contained in the tincture, fluid extract, and extract, and the least active in the infusion; all of which preparations of digitalis are official:

Tinctura Digitalis, U. S. P. *Dose,* 5–20 min. (0.3–1.3 c.c.).
Fluidextractum Digitalis, U. S. P. *Dose,* 1–2 min. (0.06–0.12 c.c.).
Extractum Digitalis, U. S. P. *Dose,* 1/6–1/2 gr. (0.01–0.03 gm.).
Infusum Digitalis, U. S. P. *Dose,* 1–4 fl. dr. (4.0–15.0 c.c.).

Physiologic Action.—Digitalis is a powerful cardiac stimulant. It does not increase the rapidity of the heart's action; it rather slows the pulsations and raises the blood-pressure, but in spite of this the

efficiency of the contraction is increased and the pulse improved in character. In therapeutic doses the drug has practically no effect except on the circulation. The slowing of the pulse results from a prolongation of the diastole, and this in turn is due to stimulation of the vagi. The increased blood-pressure is due to the twofold action of the drug, that of securing efficiency by the direct action upon the heart, and to the contraction of the arterioles, which results indirectly from the stimulation of the vasomotor center, and directly from the action on the vessel-walls. In cases of low arterial pressure, when the urine is scanty, digitalis acts as a diuretic.

Poisoning and Treatment.—Digitalis is more rapidly absorbed than eliminated; because of this, *cumulative action* may follow the prolonged use of the drug even in therapeutic doses. Toxic symptoms may result from this source or from the ingestion of a single poisonous dose. Poisoning is characterized by gastrointestinal disturbances, abdominal pains, vomiting, and purging; the pulse is slowed, respiration feeble, pupils dilated, headache, delirium, and stupor. If a fatality results, it is generally from ten to forty-eight hours after the ingestion of the drug, as digitalis is a slow poison. In the *treatment of poisoning*, the stomach-pump should be employed. Tannic acid is a chemic antidote and may be given. Body temperature should be maintained by external heat, especially applied to the abdomen. Alcoholic stimulants are often indicated. The patient should be kept in the recumbent position, not being allowed to even raise his hand or head from the bed.

Therapeutics.—The chief use of the drug in dental therapeutics is as a cardiac stimulant. Hypodermic injections of the tincture of digitalis or of digitalin may be employed to increase the efficiency of the heart's action in *syncope*, *collapse*, and *poisoning* by cardiac depressants. It is best here to use the drug in conjunction with stimulants which act more quickly (alcoholic stimulants). The drug is contraindicated in cases of *aneurysm*.

AMYLIS NITRIS—U. S. P.

(Amyl Nitrite; $C_5H_{11}NO_2$.)

Amyl nitrite is prepared by the action of nitric acid upon amylic alcohol; the product, being a highly volatile liquid, is obtained by distillation. It has a strong ethereal odor.

Physiologic Action.—Following the inhalation of amyl nitrite there is a marked flushing of the face, due chiefly to the dilatation of the

capillaries. The heart's action is increased, and the pulse is soft and compressible. There is a marked fall in blood-pressure because of the dilatation of the arterioles, which results from the paralyzant action of the drug upon the muscle fibers found in these structures. The nitrites cannot be regarded as powerful cardiac stimulants, but their action is equivalent to such, for by dilating the arterioles they largely remove the resistance against which the heart has to force the blood, thus making the work of this organ much easier to perform. These drugs, therefore, should be regarded as vasodilators, and not as true cardiac stimulants; but, on account of their action as vasodilators, they may be considered circulatory stimulants. The drug is largely eliminated through the kidneys.

Poisoning and Treatment.—In toxic doses amyl nitrite produces an exceedingly rapid and weak heart, cyanosis, slow and shallow respiration, vertigo, headache, and disordered vision. Death resulting from cardiac and respiratory failure. In the *treatment of poisoning* the heart's action must be sustained. Strychnin and digitalis will be found useful. Atropin may be administered, together with cold applications to the head, alcoholic stimulants, and, if necessary, artificial respiration. Adrenalin is claimed to be useful as it contracts the dilated arterioles.

Therapeutics.—Long[1] states that it is to be regretted that the nitrites have been considered direct heart stimulants, because of this they are extensively used in cases where the blood-pressure is already too low to permit efficiency of circulation, as in chloroform and other drug poisoning. Amyl nitrite is useful to relax *spasms* and to lower artérial tension. On account of the rapidity with which the drug is absorbed it is never necessary to give nitrites hypodermically. The effect of amyl nitrite may be obtained almost instantly by inhalation, and a dose of spirit of nitroglycerin (1–3 min.—0.06–0.2 c.c.) placed under the tongue will produce its full effect in less than five minutes. Amyl nitrite may be obtained in glass capsules or pearls, containing the requisite dose (2–5 min.—0.13–0.3 c.c.), which are easily crushed in a handkerchief, and should always be given by inhalation. In this manner it may be employed with benefit to relieve the *convulsions* of *epilepsy, tetanus, uremia,* and *strychnin poisoning*. The drug is used in *syncope* and *collapse* from other causes, but the diffusible stimulants are far preferable.

[1] Dental Materia Medica, Therapeutics and Prescription Writing.

GLYCERYLIS NITRAS.

(Nitroglycerin; Glonoin; Glyceryl Trinitrate; $C_3H_5(NO_3)_3$.)

Nitroglycerin is obtained by nitric acid or a mixture of nitric and sulphuric acid on dehydrated glycerin. It occurs as a clear, colorless liquid, with an odor and taste resembling that of alcohol. It explodes with great force, and should be kept in a cool place, away from lights and fire. It is official in the following form:

Spiritus Glycerylis Nitratis, U. S. P. (Spirit of Nitroglycerin; an alcoholic solution containing 1 per cent. by weight of Glyceryl Trinitrate). *Dose*, 1–3 min. (0.06–0.2 c.c.).

Physiologic Action and Therapeutics.—Nitroglycerin is preferable to amyl nitrite, whose action it resembles, for internal administration. It is used in dentistry as a cardiac stimulant, and for this purpose it may be found as a constituent of local anesthetic solutions. It, however, is far inferior to strychnin or atropin as an agent to overcome the depressant effect of cocain upon the heart.

Nitroglycerin is a valuable drug in those cases where it is desirous of relieving blood pressure. For example, when it is deemed necessary to apply arsenic trioxid to a pulp which is in an inflammatory state, the engorged capillaries may be relieved and the pain mitigated by the administration of this drug (see page 287).

RESPIRATORY STIMULANTS.

These are agents which *increase the functional activity of the respiratory centers or the efficiency* of the respiratory apparatus. The chief respiratory stimulants are:

Belladonna (Atropin).	Strychnin.*
Ammonia.*	Caffein.*

All of these drugs have been elsewhere discussed except the first-mentioned.

BELLADONNA.

(Deadly Nightshade.)

Belladonna is a herbaceous perennial plant growing in the woods, chiefly in the mountainous districts of central and southern Europe. Both the *dried leaves* (*Belladonna Folia, U. S. P.*) and the *dried root* (*Belladonna Radix, U. S. P.*) of *Atropa Belladonna* are official. The drug contains an important alkaloid, *atropin*, to which its physiologic activity is due. The dose of the powdered leaves and root is from 1–5 gr. (0.06–0.3 gm.). The following preparations are official

Tinctura Belladonnæ Foliorium, U. S. P. *Dose*, 5–20 min. (0.3–1.3 c.c.).
Extractum Belladonnæ Foliorium, U. S. P. *Dose*, 1/8–1/4 gr. (0.008–0.016 gm.).
Emplastrum Belladonnæ, U. S. P.
Unguentum Belladonnæ, U. S. P. (10 per cent.).
Fluidextractum Belladonnæ Radicis, U. S. P. *Dose*, 1–3 min. (0.06–0.2 c.c.).
Linimentum Belladonnæ, U. S. P. (contains Camphor, 5 parts; fluid extract of Belladonna Root, 95 parts).

The action of belladonna is due entirely to atropin which it contains. This alkaloid is official.

ATROPINA—U. S. P.

Atropin occurs in the form of white, acicular crystals, or a crystalline powder, odorless, having a bitter, acrid taste; soluble in 130 parts of water, 3 parts of alcohol, 10 parts of ether, 4 parts of chloroform, and about 50 parts of glycerin. One salt of atropin is official (Atropinæ Sulphas, U. S. P.), and in appearance resembles the alkaloid itself, except it is more freely soluble in water. The dose of atropin or of its salt is from 1/120 to 1/40 gr. (0.005–0.0016 gm.).

Physiologic Action.—The action of belladonna is dependent upon the amount of contained atropin. Applied locally in combination with absorbable substances—alcohol, camphor, animal fat, glycerin, etc.—atropin acts as a depressant to all highly organized tissues, exerting an analgesic and antisecretory influence. Medicinal doses of atropin, taken internally, produce dryness of the throat, dilatation of the pupils, quickening of the pulse, deepening of the respirations, and occasionally talkative delirium and erythematous rash. It is well to remember here that medicinal doses stimulate the respiratory center, while toxic doses paralyze it.

The salivary secretion is lessened through paralysis of the peripheral endings of the secretory fibers only of the chorda tympani nerve in the submaxillary gland (Butler). The drug also diminishes all of the secretions of the body, and its elimination is effected chiefly through the kidneys.

Poisoning and Treatment.—The characteristic symptoms of *atropin-poisoning* are dryness of the throat, dilated pupils, rapid pulse, quick respiration, uneasiness, talkative delirium, erythematous rash, and, ultimately, stupor, collapse, and death from paralysis of the respiratory center. In the *treatment of poisoning* the stomach should be evacuated and then washed out with solutions of tannic acid—

the chemic antidote. Cardiac and other respiratory stimulants (caffein) should be cautiously administered as the symptoms indicate.

Therapeutics.—Atropin is one of the best remedies at our command for controlling the secretions of the body. In cases where it is necessary to keep the *field of operation* dry, as in *treating and filling* teeth where the rubber dam cannot be successfully adjusted, atropin may be administered a few hours previous to operating with excellent results. In *salivation* from mercury the drug is likewise useful. In *hyperidrosis* of the hands and feet preparations of belladonna is used both externally and internally. Combined with camphor and other drugs, extract of belladonna is a useful remedy in *acute coryza*. Probably the greatest use atropin has in dental therapeutics is in the treatment of *shock* and *collapse* from local and general anesthetics, and also in the treatment of *poisoning from narcotic drugs*. In these cases atropin sulphate, hypodermically administered, stands next to strychnin and its salts.

Liniment of belladonna is a valuable remedy in the treatment of *neuralgia*.

GASTRIC STIMULANTS.

Gastric stimulants, called also *stomachics*, are agents which sharpen the appetite and promote the functional activity of the stomach. The gastric stimulants are called "bitter tonics," and they include the following:

Gentian. Cinchona.*
Wild Cherry. Hydrastis.*
Nux Vomica.*

GENTIANA—U. S. P.

(Gentian.)

Gentian is the *dried rhizome* and *roots* of *Gentiana lutea*, a small perennial plant indigenous to the mountainous districts of central Europe. It contains a bitter glucosid, *gentiopicrin*, to which its stomachic property is due. The dose is from 5–20 gr. (0.3–1.3 gm.). The official preparations are:

Tinctura Gentianæ Composita, U. S. P. (10 per cent. with Orange Peel and Cardamon Seed). *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Fluidextractum Gentianæ, U. S. P. *Dose*, 15–30 min. (1.0–2.0 c.c.).
Extractum Gentianæ, U. S. P. *Dose*, 2–10 gr. (0.13–0.6 gm.).
Infusum Gentianæ Compositum (Unofficial). *Dose*, 1/2 to 1 fl. oz. (15.0–30.0 c.c.).

Physiologic Action and Therapeutics.—The action of gentian is due to the bitter glucosid which it contains, and like all bitter tonics its effect is immediate, due to the local action of the drug. It augments the secretions from the salivary and gastric glands, and thus aids digestion and improves nutrition. There is an intimate relationship between the stomach and the senses of taste and smell, and anything bitter in the mouth reflexly stimulates the gastric secretion.

Gentian is not much employed in dental practice. It may be considered one of the most reliable bitter tonics. In *pyorrhea alveolaris* associated with *neuralgia* due to a general atonic condition, the compound tincture of gentian may be advantageously combined with tincture of valerian (equal parts of the two) and given before meals in teaspoonful doses. Where the pyorrhea has caused indigestion an antacid, like sodium bicarbonate, may be combined with some preparation of gentian; because of the insolubility of sodium bicarbonate in alcohol, the compound infusion of gentian should be selected. A useful combination is: Sodium bicarbonate, 1/2 dr. (2.0 gm.); compound infusion of gentian, 3 fl. oz. (90.0 c.c.). This may be given in tablespoonful doses, before meals.

PRUNUS VIRGINIANA—U. S. P.

(Wild Cherry.)

Prunus virginiana is the *bark* of *Prunus serotina*, a large tree indigenous to North America. It contains tannic acid, a bitter principle, a ferment, *emulsin*, and a glucosid, *amygdalin*. In the presence of the ferment and water the glucosid is broken up into *hydrocyanic acid* and a *volatile oil*. The dose of wild cherry bark is from 1/2–1 dr. (2.0–4.0 gm.). The following preparations are official:

Fluidextractum Pruni Virginianæ, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
Syrupus Pruni Virginianæ, U. S. P. *Dose*, 1–4 fl. dr (4.0–15.0 c.c.).
Infusum Pruni Virginianæ, U. S. P. *Dose*, 1/2–2 fl oz. (15.0–60.0 c.c.).

Physiologic Action and Therapeutics.—Wild cherry is a bitter tonic. It might also be considered a sedative tonic. While it is peculiarly bitter, it is not unpleasant, and is well tolerated by the stomach. The syrup of wild cherry is a common ingredient in "cough-mixtures," and is supposed to quiet the cough and allay the irritability of the nervous system in *bronchial trouble*. This effect is doubtless due to the hydro-

cyanic acid which it contains. The syrup has an agreeable taste and serves as an excellent vehicle for unpalatable drugs.

The other stomachics have been discussed under other headings.

RESTORATIVE STIMULANTS.

These are agents which maintain or restore the bodily functions. The principal restorative stimulant is:

NORMAL SALINE SOLUTION.

This is a solution of 6 parts of sodium chlorid in 1,000 parts of sterile water, and closely corresponds in salinity to blood-serum. It is regarded as a valuable stimulant in cases of *shock* or *collapse*, especially from loss of blood by *hemorrhage*. It is injected intravenously by permitting the solution, quite hot, to run slowly through a large-sized, long hypodermic needle from a fountain syringe into the lumbar region or underneath the breast. From 2 fl. oz. (60.0 c.c.) to 10 fl. oz. or even 1 qt. (300.0–1,000 c.c.) may be used at frequent intervals. Sollmann[1] states that the action is only short, and the injection must therefore be repeated. The restoration is brought about by the substitution of this fluid for the blood-serum. The solution is an excellent bland remedy to be used in establishing sinuses associated with alveolar abscesses, and also as a vehicle for local anesthetics and other agents (adrenalin, etc.).

MISCELLANEOUS GROUP.

There are several drugs which have a peculiar action upon the nervous system other than those thus far discussed under the various headings of general remedies. Some of these drugs stimulate, while others depress the nervous system. They will be considered here under this heading. Those of importance to dentists are:

Gelsemium.	Valerian.

GELSEMIUM—U. S. P.

(Yellow Jasmine.)

Gelsemium is the *dried rhizone* and *roots* of *Gelsemium sempervirens*, a climbing plant growing in the moist woods of southern United States. It contains two alkaloids—*gelsemin* and *gelseminin*—the former stimulates, while the latter depresses the nervous system. The general effect of the drug is the result of a blending of the actions of

[1] A Text-Book of Pharmacology.

the two alkaloids, although in man gelseminin appears to be more potent. The dose of powdered gelsemium is from 2–5 gr. (0.13–0.3 gm.). The official preparations are:

Tinctura Gelsemii, U. S. P. *Dose,* 10 to 30 min. (0.6–2.0 c.c.).
Fluidxetractum Gelsemii, U. S. P. *Dose,* 2–10 min. (0.13–0.6 c.c.).

Physiologic Action and Therapeutics.—Gelsemium has a distinct action upon sensory nerves and is useful, therefore, in painful affections. In large doses it depresses the spinal cord, especially its motor neurons. The drug is used in *trifacial neuralgia,* and appears to be most serviceable when the neuralgia arises from diseased conditions of the teeth. The fluid extract is the preparation generally employed, although Marshall[1] prefers gelseminin sulphate, giving 1/30 gr. (0.002 gm.) every two hours until the constitutional effects are produced. This salt naturally would be more effective in neuralgic conditions than gelsemium preparations, as it is the alkaloid that depresses the nervous system; the other alkaloid (gelsemin) stimulates.

Poisoning and Treatment.—The toxic symptoms of gelsemium are drooping eyelids, disordered vision, frontal headache, falling of the jaw, muscular weakness, slow respiration, and, finally, collapse. In the *treatment of poisoning* the stomach should be evacuated, tannic acid administered as the chemic antidote, and combating collapse with such stimulants as strychnin, whisky, and ammonia.

VALERIANA—U. S. P.

(Valerian.)

Valerian is the *dried rhizome* and *roots* of *Valeriana officinalis,* a herbaceous, perennial plant, native of Europe. It contains *valerianic acid* and a *volatile oil.* The dose is from 15–30 gr. (1.0–2.0 gm.). The following preparations are official:

Tinctura Valerianæ, U. S. P. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Tinctura Valerianæ Ammoniata, U. S. P. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Fluidextractum Valerianæ, U. S. P. *Dose,* 1/2–1 fl. dr. (2.0–4.0 c.c.).

Physiologic Action and Therapeutics.—The principal action of valerian is upon the nervous system, and it may be classed as a *nervine* in that it produces, in moderate dose, a sedative effect upon

[1] Injuries and Surgical Diseases of the Face, Mouth and Jaws.

the brain and spinal cord. In *pyorrhea alveolaris* associated with more or less *neuralgia* due to a general atonic condition it may be combined with gentian with excellent results.

ALTERATIVES AND RESTORATIVES.

Alteratives are agents which promote metabolic processes and thus counteract morbid conditions. They are closely related to **Restoratives** in that both classes promote the processes of nutrition and aid metabolism. The latter class includes *foods, hematics*, and *tonics*.

Foods are substances which, when introduced into the body, supply material with which some structure is rebuilt or some vital process is maintained. They differ from medicines in that the latter modify vital processes, but furnish no material to renew the structures of the body.

Hematics or hematinics are agents which increase the hematin in the blood and restore or maintain bodily functions by enriching the red blood-corpuscles. The compounds of iron are the chief hematics.

Tonics are agents which improve the tone and impart strength and energy to the tissues. The main tonics are:

Iron and Compounds.
Phosphorus.
Calcium Phosphate.
Hypophosphites.
Cod-liver Oil.
Nux Vomica.*
Cinchona.*

The principal alteratives are:

Potassium Iodid.
Mercury.
Arsenic.*
Sarsaparilla.
Echafolta.
Calx Sulphurata.
Gold and Sodium Chlorid.

FERRUM—U. S. P.

(Iron; Fe.)

Metallic iron is official in the form of wire.

Physiologic Action and Therapeutics.—Iron is an essential element of the body and may be regarded as a food as well as a medicine. It enters as an essential constituent (0.4 per cent.) into a peculiar proteid body—the hemoglobin of the blood. It is through the iron compounds of the body that the greater portion of the oxidizing functions of the various cells are carried on. In a healthy state of the body, when the processes of mastication, digestion, assimilation, and nutrition are

normal, there is a sufficient amount of iron furnished by the mixed diet to answer all physiologic requirements; but in many pathologic conditions there is a deficiency of iron, and the element must be furnished in the form of selected food or medicine. There is a difference of opinion as to whether metallic iron can be assimilated by the body; some authorities claiming that it is necessary to first have the iron organized by plant life into compounds containing it, while others claim that this is not necessarily essential to the assimilation of the metal. Metallic iron is not used as a therapeutic agent in dentistry. In medicine it is extensively employed in diseases which affect the circulation, as *anemia* and *chlorosis*. Many iron compounds are used in dentistry and will here be considered.

Iron Compounds.—Iron forms two series of compounds—*ferrous* and *ferric*. The former are white when freshly precipitated in the absence of oxygen, but when moist and exposed to air they readily absorb oxygen and gradually change into ferric compounds, which are usually reddish-brown in color. In this change there is an array of four distinct colors—white, green, black, and brown, respectively—and in the blending of these colors there may be produced every variety of shades seen in discolored teeth. As it is quite generally conceded that iron is the most important element to be considered in the many factors entering into the complicated problem of tooth discoloration from pulp decomposition, the above fact should be remembered.

With the exception of the carbonate, the hydroxid, and the hypophosphite, all of the compounds of iron are freely soluble in water, but insoluble in alcohol. The so-called *scaled* salts are all ferric compounds of phosphoric acid, or the organic acids, citric and tartaric; they are rendered more soluble in combination with citrates, tartrates, and phosphates of the respective alkalies—ammonium, potassium, and sodium—and some are known as "soluble" salts. The scale salts are comparatively free from astringency, usually well borne by the stomach, and are used in medicine as mild and agreeable *hematinics*. The dose, with one exception (that containing strychnin), is 4 gr. (0.25 gm.). The official Latin titles do not distinguish between the *ferrous* and *ferric* compounds, but they are so distinguished in the English titles. The iron compounds used in dental therapeutics here follow.

FERRI SULPHAS—U. S. P.

(Ferrous Sulphate; Green Vitriol; $FeSO_4.7H_2O$.)

Ferrous sulphate occurs in the form of bluish-green, efflorescent prisms, odorless, having a saline, styptic taste. It is freely soluble in

water, insoluble in alcohol. The dose is from 1–5 gr. (0.06–0.3 gm.). The official preparations are:

Ferri Sulphas Exsiccatus, U. S. P. *Dose*, 1–3 gr. (0.06–0.2 gm.).
Ferri Sulphas Granulatus, U. S. P. *Dose*, 1–5 gr. (0.06–0.3 gm.).

Physiologic Action and Therapeutics.—Iron sulphate is an active astringent. It may be applied to *canker sores*, but is inferior to copper sulphate. It is frequently used as a deodorant for privies and cesspools.

FERRI SUBSULPHAS—Unofficial.

(Ferric Subsulphate; Basic Ferric Sulphate; Monsel's Salt; $Fe_4O(SO_4)_5$.)

Ferric subsulphate occurs as a yellow, hygroscopic, astringent powder, freely soluble in water. There is one official preparation:

Liquor Ferri Subsulphatis, U. S. P. (Monsel's Solution). *Dose*, 3–5 min. (0.2–0.3 c.c.).

Physiologic Action and Therapeutics.—Monsel's salt or the official solution (Monsel's solution) is a prompt and powerful styptic, and as such it has long been used in dentistry. When the *hemorrhage* proceeds from a tooth-socket it is better to use the salt than the solution, for the reason that the hard black clots formed by the latter may conceal the deep-seated hemorrhage. The salt can be incorporated in moist cotton and, after washing the socket, the medicated cotton should be packed tightly into it. Sometimes it is necessary to hold the packing firmly for some time in order to control the hemorrhage.

FERRI CHLORIDUM—U. S. P.

(Ferric Chlorid; Iron Perchlorid; $Fe_2Cl_6.12H_2O$.)

Ferric chlorid occurs in orange-yellow, crystalline pieces, having an astringent taste. It is a highly deliquescent salt, and therefore freely soluble in water, also in alcohol. The official preparations are:

Liquor Ferri Chloridi, U. S. P. *Dose*, 3–10 min. (0.2–0.6 c.c.).
Tinctura Ferri Chloridi, U. S. P. *Dose*, 5–30 min. (0.3–2.0 c.c.).
Liquor Ferri et Ammonii Acetatis, U. S. P. *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Physiologic Action and Therapeutics.—Ferric chlorid is an active astringent and styptic. It is employed in the control of *hemorrhage*, after the *extraction of teeth*, *removal of small growths*, etc.

As a styptic in dental therapeutics, it is inferior to Monsel's solution or salt. The tincture has a deleterious action upon the teeth, and should be used about the mouth with caution.

Ferrum Dialysatum (Dialysed Iron).—This is an unofficial preparation of iron oxychlorid from which acidulous matter has been separated by dialysis, hence the name, *dialysed iron*. It is a dark red, neutral liquid, without odor or taste. It has been employed freely as a local antidote in *arsenical poisoning*. Dentists have been prone to rely upon this agent when other remedies would serve better (see p. 291).

FERRI CARBONAS—Unofficial.

(Ferrous Carbonate; $FeCO_3$.)

Ferrous or **iron carbonate** is an unstable compound which is readily converted into ferric hydroxid (hydrate) when moist and exposed to air—a characteristic of most *ferrous* compounds. The salt may be protected from oxidation and enters into the following official preparations:

Ferri Carbonas Saccharatus, U. S. P. *Dose*, 5–15 gr. (0.3–1.0 gm.).
Mistura Ferri Composita, U. S. P. *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).
Massa Ferri Carbonatis, U. S. P. (Vallet's Mass). *Dose*, 3–5 gr. (0.2–0.3 gm.).
Pilulæ Ferri Carbonatis, U. S. P. (Blaud's Pills, each containing one gr. of pure Ferrous Carbonate). *Dose*, 1–3 pills.

Physiologic Action and Therapeutics.—Ferrous carbonate acts as a tonic, and the preparations containing it, being free from astringency, may be used whenever iron is demanded by the tissues. The preparations are especially useful in *anemia*.

FERRUM REDUCTUM—U. S. P.

(Reduced Iron; Iron by Hydrogen.)

Reduced iron occurs as a fine, grayish-black, insoluble powder, without odor or taste. It should contain not less than 90 per cent. of metallic iron. It is a valuable *hematinic*, as it is free from astringency and has little tendency to cause constipation. The dose is from 1–5 gr. (0.06–0.3 gm.) given in the form of pills, capsules, or lozenges.

FERRI HYDROXIDUM—U. S. P. AND FERRI HYDROXIDUM CUM MAGNESII OXIDO—U. S. P.

(Ferric Hydroxid; $Fe_2(OH)_6$, and Ferric Hydroxid with Magnesia.)

Ferric hydroxid is made by adding ammonia water to a solution of ferrous sulphate, collecting and washing the precipitate. **Ferric hydroxid with magnesia** is made in the same manner except magnesia is added in excess. Both preparations are used exclusively as internal antidotes in *arsenical poisoning.* They should be freshly made and given freely, while still moist, in tablespoonful doses or more every few minutes. Ferric hydroxid with magnesia is preferable, as it requires no washing of the precipitate, and the magnesia itself is antidotal.

FERRI IODIDUM—Unofficial.

(Iron Iodid; FeI_2.)

Ferrous iodid occurs in grayish-white, crystalline masses; soluble in water with partial decomposition. It enters as an essential constituent into the following official preparations:

Syrupus Ferri Iodidi, U. S. P. (5 per cent.). *Dose,* 5–60 min. (0.3–4.0 c.c.).
Pilulæ Ferri Iodidi, U. S. P. (1 gr.–0.06 gm., each). *Dose,* 1–3 pills.

Physiologic Action and Therapeutics.—Iron iodid acts as an alterative, and as such is used in certain *syphilitic conditions.* The syrup is injurious to the tooth structure, and it should be taken through a tube, or given well diluted with instructions to thoroughly rinse the mouth after its administration.

FERRI HYPOPHOSPHIS—U. S. P.

(Ferric Hypophosphite.)

This salt occurs as a white powder, odorless, and practically tasteless. It is but sparingly soluble in water. The dose is from 5–10 gr. (0.3–0.6 gm.). It is contained in the following preparation:

Syrupus Hypophosphitum Compositus, N. F. *Dose,* 1–4 fl. dr. (4.0–15.0 c.c.).

This preparation is adopted from the National Formulary, and is similar to a number of proprietary syrups of hypophosphites. The preparation is used as an alterative and hematinic.

PHOSPHORUS—U. S. P.

(P.)

Phosphorus occurs as a translucent, nearly colorless solid, of a waxy luster, and at ordinary temperatures having about the consistence of beeswax. When kept for some time the surface becomes red and occasionally black. When exposed to air it emits white fumes, visible in the dark, which have an odor somewhat like garlic. Upon prolonged exposure to air it takes fire spontaneously. The drug should be carefully kept under water, in which it is practically insoluble, in strong, well-closed vessels. The dose is from 1/100–1/30 gr. (0.0006–0.002 gm.). The following preparation is official:

> Pilulæ Phosphori, U. S. P. (each pill contains 1/100 gr.–0.0006 gm.). *Dose*, 1–3 pills.

Physiologic Action.—Phosphorus stimulates the bone-forming tissues, when given in small doses, rendering the bones more dense, diminishing the cancellous structure, and, if the administration of the drug is continued, the marrow-cavity becomes more or less obliterated. There has been a difference of opinion among investigators as to how this result was brought about. Some believed that an excess of phosphates was deposited, while others felt that it was due to a specific irritation of the bone-forming cells, causing stimulation. The latter theory is more nearly correct, for Wegner has shown by a series of experiments on growing animals fed with phosphorus, but deprived of phosphates, that the same hyperplasia in the bones resulted, but that the new tissue was soft and gelatinous instead of hard. The dominant action of phosphorus is upon the osseous system. Stevens claims, however, that there is considerable clinical testimony to show that the drug improves the nutrition of other tissues, especially of the nervous system. Phosphorus is extensively used in the manufacture of matches, and the fumes so common in these factories often produce the most serious results. Where dental caries is present extensive maxillary necrosis has been reported by Brophy and others, as well as great irritation of the conjunctivæ and the respiratory mucous membrane. In most match factories a strict rule is adopted requiring the employees to have their teeth examined at stated intervals and, if found necessary, put in order.

Poisoning and Treatment.—The effects of a toxic dose of phosphorus are not generally manifested for several hours after its ingestion. The earliest symptoms are intense abdominal pain, persistent vomiting, thirst, a garlicky taste in the mouth, restlessness, and prostration. At

the end of twenty-four to thirty-six hours, these acute symptoms gradually subside, and the hope is raised that the patient will surely recover, but frequently after a lapse of a few hours, or even two or three days, the symptoms of the acute stage may recur. In these cases there is great weakness, the symptoms becoming more acute, mucus, bile, and occasionally disintegrated blood being contained in the ejected material, which for a time retain the odor and luminosity of phosphorus; jaundice develops; the liver becomes enlarged and painful, and the pulse grows very feeble. In fatal cases death generally occurs in from a few days to two weeks, and is often preceded by delirium, convulsions, stupor, and coma.

In the *treatment of phosphorus poisoning*, if the drug has recently been taken, emetics and purgatives are from the first necessary. Copper sulphate is considered the most efficient emetic as well as the best chemic antidote, since any excess forms with the phosphorus—the insoluble copper phosphid. Since oily and fatty substances are active solvents for phosphorus, all such material should be withheld. Castor oil, then, as a cathartic, should not be used.

As prophylactic measures for the protection of workmen against phosphor-necrosis, masks covering the mouth and nose have been found serviceable, as well as the inhilation of the vapor of turpentine obtained by suspending a small vial of the fluid at the neck. As has been mentioned, the teeth should be examined, especially for caries, at stated intervals, since the presence of carious teeth favors the tendency to maxillary necrosis.

Therapeutics.—Phosphorus is employed as a tonic to the osseous tissues and in certain diseases of the nervous system that are dependent upon exhaustion rather than upon organic changes. In *neurasthenia* and *chronic nervous exhaustion* it is a useful therapeutic agent. Some cases of *neuralgia*, particularly of the fifth nerve and accompanied by great debility, may be relieved by full doses administered every four hours (Butler). The drug has proved efficacious in *caries*, *delayed union of fractures*, *osteomalacia*, and *rachitis* (rickets). In *functional impotence* from sexual excess, phosphorus is also a valuable remedy. The pill is considered the most stable, and therefore the best preparation in which to administer the drug.

ACIDUM PHOSPHORICUM—U. S. P.

(Phosphoric Acid; Orthophosphoric Acid; H_3PO_4.)

Under Phosphorus it was stated that when exposed to air the drug burns, emitting white fumes. Chemically considered, this means

that phosphorus combines directly with oxygen to form phosphorous pentoxid (P_2O_5). This oxid is capable of combining chemically with one, two, or three molecules of water, forming thereby three different acids, as:

$P_2O_5+H_2O=H_2P_2O_6=2HPO_3$,	Metaphosphoric Acid.
$P_2O_5+2H_2O=H_4P_2O_7$,	Pyrophosphoric Acid.
$P_2O_5+3H_2O=H_6P_2O_8=2H_3PO_4$,	Orthophosphoric Acid.

These three acids show different reactions, act differently upon the animal system, and form different salts. The acid of phosphorus recognized by the United States Pharmacopeia is a colorless liquid, composed of 85 per cent. by weight of absolute orthophosphoric acid and 15 per cent. of water. It has a strong acid taste. The dose is from 3–5 min. (0.2–0.3 c.c.), well diluted. There is an official diluted phosphoric acid (*Acidum Phosphoricum Dilutum*, U. S. P., 10 per cent.) which is usually employed when phosphoric acid is indicated, the dose of which is from 10–60 min. (0.6–4.0 c.c.) in water.

Physiologic Action and Therapeutics.—The action of phosphoric acid is somewhat like that of the dilute mineral acids, and has no relation to the action of phosphorus itself. In medicine the drug is used to allay *thirst in diabetes* and *febrile diseases*, and to *promote gastric digestion.* The acid has practically no use in dental therapeutics, but is discussed here because phosphoric acid (modified somewhat) is the liquid combined with *zinc oxid* (cement powder) to make the *zinc phosphate cement*, so extensively used in dental practice. Nearly all of the phosphates found in nature are orthophosphates.

CALCII PHOSPHAS PRÆCIPITATUS—U. S. P.

(Precipitated Calcium Orthophosphate; Bone Phosphate; $Ca_3(PO_4)_2$.)

Precipitated calcium phosphate occurs as a white, odorless, tasteless, amorphous powder; insoluble in cold water and alcohol. The dose is from 5–30 gr. (0.3–2.0 gm.). There is one official preparation:

Syrupus Calcii Lactophosphatis, U. S. P. (contains about 3 per cent. of the double soluble salt). *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Physiologic Action and Therapeutics.—Calcium phosphate may be taken as the type of the insoluble salts of calcium, which are so frequently referred to in dental literature as "lime-salts." Lime is calcium oxid, and as there is no such thing in chemistry as a salt of an oxid, this term, *lime-salts*, should be discarded. When taken internally, calcium phosphate, for the most part, resists absorption and reappears

in the stools; a small amount, however, is assimilated, and in case of a deficiency of phosphates in the food is appropriated by the tissues. Where the phosphates in the natural food-supply meet all physiologic requirements, any excess of the insoluble calcium salts is slowly excreted by the intestinal epithelium and kidneys. Food ordinarily contains more calcium phosphate than the body requires; it is, therefore, difficult to explain how the insoluble salts of calcium (phosphate and hypophosphite), administered as a remedy, can be of any physiologic importance. Stevens[1] states that the difficulty, however, is no greater than that which is encountered in attempting to explain the undoubted efficacy of iron in chlorosis, a disease that is certainly not dependent upon a want of iron salts in the food. There is no convincing evidence to show that the insoluble calcium salts are of much value in themselves as therapeutic agents. On theoretical grounds they have been prescribed to prevent the *rapid decay of teeth* during *pregnancy* and the *nursing period,* in *osteomalacia,* and in *rachitis.* They seem to exert a favorable influence on general nutrition in such diseases as *chlorosis, anemia, scrofula, tuberculosis, tertiary syphilis,* and *neurasthenia.* Calcium phosphate may be given in powders or capsules; the lacto-phosphate, being soluble, may be administered in the form of the official syrup or in an emulsion of cod-liver oil.

As a vehicle for making pastes used in *capping pulps, filling tortuous root canals, bleaching teeth,* etc., the author recommends combining precipitated calcium phosphate with thymol (2 per cent.). This will be explained in Practical Therapeutics (see page 273).

CALCII HYPOPHOSPHIS—U. S. P.

(Calcium Hypophosphite; $Ca(PH_2O_2)_2$.)

Calcium hypophosphite occurs in colorless, transparent crystals, or small lustrous scales, having a bitter, nauseating taste. It is soluble in about 7 parts of water, insoluble in alcohol. The dose is from 5–30 gr. (0.3–2.0 gm.). It enters as an important constituent into the following official preparations:

Syrupus Hypophosphitum, U. S. P. *Dose,* 1—2 fl. dr. (4.0—8.0 c.c.).
Syrupus Hypophosphitum Compositus, U. S. P. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Emulsum Olei Morrhuæ cum Hypophosphitibus, U. S. P. (emulsion of Cod-liver Oil with Hypophosphites). *Dose,* 1–8 fl. dr. (4.0–30.0 c.c.).

[1] Modern Materia Medica and Therapeutics.

Physiologic Action and Therapeutics.—The action of hypophosphites, of which the calcium salt is a fair representative, is similar to that of calcium phosphate, and they may be employed as therapeutic agents in the same class of cases in which the latter has been recommended. Calcium hypophosphite, being more soluble in water, may be assimilated more readily, but the same remarks hold true with this agent as were made with calcium phosphate in regard to the power of the system to utilize the agent in the constructive processes of the body.

OLEUM MORRHUÆ—U. S. P.

(Cod-liver Oil.)

Cod-liver oil is a fixed oil obtained from the *fresh livers* of *Gladus morrhua* and other species of *Gladus*. It occurs as a thin, pale yellow liquid, having a characteristic fishy odor and taste. It contains the glycerids of olein, palmitin, and stearin, traces of iodin, bromin, chlorin, phosphorus, sulphur, biliary salts, and several alkaloids (leucomains). The dose is from 1–4 fl. dr (4.–15.0 c.c.). The official preparations are:

Emulsum Olei Morrhuæ, U. S. P. (50 per cent.). *Dose*, 1–8 fl. dr. (4.0–30.0 c.c.).
Emulsum Olei Morrhuæ cum Hypophosphitibus, U. S. P. (Cod-liver Oil 50 per cent., with Calcium, Potassium, and Sodium Hypophosphites). *Dose*, 1–8 fl. dr. (4.0–30.0 c.c.).

Physiologic Action and Therapeutics.—From the constituents of cod-liver oil it may readily be seen that it is a food rather than a medicine, and is a true *restorative*. In moderate doses it improves the general nutrition, increases the number of red blood-corpuscles, and favors the accumulation of fat—a normal and necessary constituent of the body. Fat is the fuel used to supply energy, and the most active tissues and organs require the most fuel. Consequently, nerves, muscles, and glands are more abundantly supplied with fat than cartilage; and, in cases of starvation, those structures demanding the greater supply must have it, at the expense of the less highly organized and active tissues. This is illustrated in certain diseases—tuberculosis, for example. Butler[1] states that the blood contains about one-half of 1 per cent. of fat; the muscles, 3 per cent.; the brain, 8 per cent.; and the nerves, 22 per cent. This equilibrium must be maintained in order that the various cells of the body may possess sufficient vitality

[1] Text-Book of Materia Medica, Therapeutics and Pharmacology.

to physiologically resist the encroachments of disease and the invasion of pathogenic bacteria. It is rather difficult to digest and assimilate ordinary fat; and this must be done before it can enter the various cells of the body and act as a food, and, consequently, be a source of energy. Cod-liver oil is more readily absorbed and oxidized than any other fat, due to the fact that it has already been prepared by the liver, and therefore partially elaborated; and also to the biliary salts which it contains, causing it to pass more readily through animal membranes.

Therapeutics.—Cod-liver oil is a valuable restorative in all *emaciating diseases* resulting in *anemia*. It is especially indicated as a nutritive tonic in *tuberculosis*. As a food it may be given in any case where fat is deficient, and therefore needed to supply energy to the tissues.

POTASSII IODIDUM—U. S. P.

(Potassium Iodid; KI.)

Potassium iodid occurs as colorless, transparent or translucent crystals or as a white granular powder, having a pungent, saline taste; soluble in 0.75 part of water, 2.5 parts of glycerin, and 18 parts of alcohol. The usual dose is from 3–10 gr. (0.2–0.6 gm.), given well diluted after meals; but in tertiary syphilis often 1 dr. (4.0 gm.) may be given with advantage. There is one official preparation:

> Unguentum Potassii Iodidi, U. S. P. (contains Potassium Iodid, 12 per cent.; Sodium Hyposulphite, 1 per cent.). The drug is also a constituent of Lugol's Solution (*Liquor Iodi Compositus*, U. S. P.).

Physiologic Action.—Potassium iodid is a true alterative and has a favorable action in a variety of morbid conditions. As is true with many drugs, potassium iodid, given in a single, moderate dose in health, produces no noticeable effects beyond a slight increase in the secretion of urine and some disturbance of the stomach, due solely to its local irritant property. The drug is rapidly absorbed from all parts of the digestive tract, and reappears in the secretions in less than fifteen minutes after its ingestion. By far, the greater portion is eliminated through the kidneys, but small quantities escape in almost every secretion of the body, as in the saliva, milk, perspiration, and even the tears. There is little doubt but what a small quantity of the drug is retained, for a time at least, by the cells of the body and that the *cumulative* action may result, for its continuous use is generally followed, sooner or later, by a group of symptoms known as *iodism*. This

condition has previously been mentioned, and in this instance results from the local irritant effects of free iodin, into which a portion of the iodid appears to be converted. There is a remarkable variance in the susceptibility of individuals to the iodids, and idiosyncrasies are frequently encountered. The amount of the drug, therefore, required to induce iodism depends upon the subject. Daily doses of from 1/4–1/2 oz. (7.5–15.0 gm.) are sometimes well borne, and, on the other hand, doses of from 2–3 gr. (0.13–0.2 gm.) a day may soon produce intense discomfort.

Therapeutics.—Potassium iodid is the one drug relied upon in nearly all cases where an alterative drug is indicated. Its best effects are observed in *tertiary syphilis*, in which stage of the disease its efficacy is equal to that of mercury in the *secondary stage*. The initial dose should be small, and the amount gradually increased until improvement follows or symptoms of iodism appear. It is necessary in syphilis to continue the treatment for six months or a year if permanent results are to be expected.

In *acute alveolar abscess* the author has secured excellent results in many cases by the repeated internal administration of small doses of potassium iodid. The nauseating taste can by masked by dissolving 1 dr. (4.0 gm.) of the drug in 3 fl. oz. (90.0 c.c.) of the compound syrup of sarsaparilla or syrup of wild cherry. One teaspoonful in water can be given every two hours until three or four doses have been taken.

Potassium iodid has been combined with expectorants, and used with advantage in *chronic bronchitis*, when the sputum is composed of thick, viscid mucus. In *morbid conditions* of the mucous membrane in *chronic catarrh* the drug is also useful. In *actinomycosis*, occurring in man, the drug has been used internally with complete success as a curative remedy in a number of cases (Stevens).

Potassium iodid is highly efficacious in *chronic metallic poisoning*, especially from lead and mercury as it aids in the elimination of the metal by forming with it in the tissues a double soluble salt.

OTHER IODIDS.

There are iodids of several metals used in medicine. **Sodium, ammonium,** and **strontium iodid** resemble potassium iodid in their action, and may be used for the same purposes; but they do not possess the virtues to the same degree ascribed to the potassium salt. Zinc iodid has different properties, due to the zinc *ion*, and has been elsewhere discussed.

HYDRARGYRUM—U. S. P.

(Mercury; Quicksilver; Hg.)

Mercury is a shining, silver-white, heavy metal, without odor or taste. It is a liquid at the ordinary temperature, and easily divided into spherical globules; but when cooled to—39.38° C. (—38.88° F.), it forms a ductile, malleable mass. The metal is insoluble in ordinary solvents, but miscible with sacchareous substances and fats, through which, by trituration, the globules may be so finely divided as not to be discernible by the naked eye, in which condition the drug is very active medicinally.

Mercury is larely used in therapeutics in the form of its compounds, but there are several official preparations in which metallic mercury is incorporated, after being reduced to the finely divided condition. They are:

Hydrargyrum cum Creta, U. S. P. (contains 38 per cent. of Mercury). *Dose*, 1/2–10 gr. (0.03—0.6 gm.).
Unguentum Hydrargyri, U. S. P. (contains 50 per cent. of Mercury).
Unguentum Hydrargyri Dilutum, U. S. P. (Blue Ointment; contains 33 per cent. of Mercury; made by mixing Ointment of Mercury, 2; Petrolatum, 1 part).
Massa Hydrargyri, U. S. P. (pill mass of Mercury; contains 33 per cent. of Mercury).
Emplastrum Hydrargyri, U. S. P. (contains 30 per cent. of Mercury with Lead Plaster, with addition of Lanolin, 10 per cent.).
Oleatum Hydrargyri, U. S. P. (contains 25 per cent. of Mercury).

Physiologic Action.—Mercury is an alterative and tonic. Every dentist should be thoroughly familiar with the action and effects of this metal. When small doses of an unirritating preparation of the drug are given continuously for a certain length of time, the first effects are observed in the mouth, for it has a selective influence upon the gums, jaws, and adjacent structures. There is produced an increased flow of saliva, fetor of the breath, redness of the gum margins, and pericementitis, causing soreness of the teeth when the jaws are forcibly brought together. If the drug is not withdrawn upon the appearance of these symptoms, the condition gradually grows worse; salivation becomes excessive (continual drooling), the gums become swollen and spongy, the teeth loosened in their sockets and may be easily extracted with the fingers, the tongue and parotid glands enlarge—the former sometimes to the extent that it protrudes from the mouth, and, finally, the soft tissues slough away, necrosis of

the bones set in, and large sequestrums form. This group of symptoms is known as *ptyalism* or *salivation*. In these cases the general health is naturally affected, the patient becoming pale and loses flesh. Chronic mercurial poisoning occurs most frequently in workmen who handle the metal or who are exposed to its fumes, such as makers of thermometers, mirrors, scientific instruments, etc. It is too frequently induced, however, by the prolonged use of mercury as a medicine.

The drug is supposed to enter into the composition of the cell by combining with the nucleinic acid, forming mercury nucleinate. It is absorbed gradually, and although every secretion of the body contributes to its general expulsion from the system, traces of the drug have been detected in the urine months after its use had been discontinued. It is, therefore, one of the slowest drugs known to be eliminated, and its *cumulative* action is a well-established fact.

Treatment of Poisoning.—If the symptoms of ptyalism are not too pronounced, discontinuance of the mercury and mouth hygiene usually clear up the symptoms. In more severe cases, besides discontinuing the use of mercury and employing prophylactic measures, certain medicinal remedies are indicated. The *teeth should not be extracted*, unless so loose that they virtually fall out. Potassium chlorate can be dissolved in cinnamon water (10 gr.–0.6 gm. to the fl. oz.—30.0 c.c.) and used as a mouth-wash. Atropin, in medicinal doses, may be used twice daily to control the flow of saliva. The internal administration of potassium iodid is recommended, as it aids in the elimination of mercury by forming with it in the tissues the double soluble salt. Where necrosis of the bones is evident, Cook and Mawhinney recommend the local application of a 50 per cent. solution of phenolsulphonic acid. This agent acts as a stimulant and hastens the formation of the sequestra. When the pain is very severe, morphin may be given; and tonics are indicated to combat the exhaustion and anemia.

Therapeutics.—Mercury and its compounds are used in general therapeutics for a variety of purposes. They act as antisyphilitics, antiparasitics, disinfectants, cathartics, and diuretics, as well as alteratives and tonics.

In *syphilis*, mercurials and the iodids act as *specifics*. Sollmann[1] states that the use of the former, as yet, rests entirely upon an empirical basis. It is not even known whether the action of mercury here is due to specific toxicity for the virus of syphilis, or whether it is due simply to the general effects upon metabolism. The former seems to be the

[1] A Text-Book of Pharmacology.

case. There is no reason to doubt that mercury is not only palliative, but curative, in the *secondary stage of syphilis*, congenital as well as acquired; while it is useless in the first and third stages. The first stage is best treated expectantly; the third, with iodids. Syphilographers have learned from sad experience that mercury can be pushed much further in the treatment of secondary syphilis without producing ptyalism if the mouth has first been placed in a hygienic condition, *i.e.*, if all irritant (deposits, overhanging fillings, etc.) have been removed by thorough prophylactic treatment.

The preparations most frequently prescribed in syphilis are mercury with chalk and compounds, like the bichlorid, biniodid, and protiodid. The ointments are used by inunction.

In *pediculosis pubis* (crab-lice) the parasites are quickly destroyed by rubbing into the affected parts a small amount of blue ointment.

It is the compounds of mercury that are most valuable in dental therapeutics. Mercury, however, is used extensively in the amalgamation of dental alloys in the preparation of dental amalgams, which occupy a prominent place in dental practice as filling material for teeth.

Many homeopathic practitioners object strenuously to the use of amalgams for filling the cavities in the teeth of their patients; some go so far as to order all amalgam fillings removed and fillings of other material substituted, in the belief that enough mercury is gradually absorbed to cause systemic disturbances. The idea is certainly far-fetched, for while metallic mercury can be separated from an amalgam by high compression or heat, it, nevertheless, is combined in the amalgam by a more or less definite chemic union. The author has no positive proof to show that mercury cannot be thus absorbed; but by close observation in a long clinical experience no constitutional disturbances from this source have been discovered. The same objections are offered to the wearing of a red-rubber denture, because mercury compounds (oxids) are used as pigments for coloring the rubber. Surely, with the high heat necessary for vulcanization, the mercury would combine with the other elements to form such insoluble (nonabsorbable) compounds that there would be no danger of systemic disturbances from this source.

COMPOUNDS OF MERCURY.

Mercury, like iron, forms two series of compounds which are not distinguished in their Latin titles as they are in their English titles: *mercurous* and *mercuric*. The former are sparingly soluble and less

active, while the latter are more readily soluble in water and alcohol and so irritant as to be classed with the *poisons*. The two classes also differ somewhat in regard to their physiologic activity. The mercurous compounds, of which the chlorid (calomel) is a type, powerfully stimulate the glandular system and are antiseptics, alteratives, and cathartics. The mercuric compounds, of which the chlorid (corrosive sublimate) is a type, are potent alteratives, and powerful antiseptics and disinfectants. It is easy to distinguish between the two classes by the different coloration produced with lime-water (liquor calcis). The former (ous) forms a black precipitate, the latter (ic), a yellow.

HYDRARGYRI CHLORIDUM MITE—U. S. P.

(Mild Mercurous Chlorid; Calomel; Hg_2Cl_2.)

Calomel occurs as a white, amorphous powder, without odor or taste. It is insoluble in all ordinary solvents. The dose is from 1/10 to 10 gr. (0.006–0.6 gm.). It is an important constituent in the following official pills:

> Pilulæ Cartharticæ Compositæ, U. S. P. (each contains Calomel, 1 gr.—0.06 gm., with Gamboge, Compound Extract of Colycinth, and Extract of Jalap). *Dose*, 1–3 pills.
> Pilulæ Antimonii Compositæ, U. S. P. (Plumber's Pills; each contains 2/3 gr.—0.04 gm.). *Dose*, 1–2 pills.

Physiologic Action and Therapeutics.—Externally applied, calomel acts as a stimulant, antiseptic, and desiccant. Internally administered, it acts as a cathartic, diuretic, and antisyphilitic. Zinc ointment to which calomel, 10 gr. (0.6 gm.) to the ounce (32.0 gm.), has been added makes an excellent application in *subacute* and *chronic eczema*, and *indolent venereal ulcers* are desiccated and much improved by dusting them with calomel.

Calomel acts as a laxative or purgative, according to the way in which it is administered and the susceptibility of the patient. It is a rather peculiar cathartic in that its effect does not increase in direct ratio with the dose, as is true with most cathartic drugs. Small doses repeated every half-hour until 1 or 2 gr. (0.065–0.13 gm.) have been taken generally operate more freely than a dose of 10 gr. (0.6 gm.) taken at once. Calomel produces a thorough evacuation, the stools being large and loose, and usually charged with undecomposed bile. Whether the drug increases the quantity of bile formed in the liver or simply hastens the flow through the intestines and prevents its reabsorption is an un-

settled question. Experimental and clinical evidence point more strongly to the latter assumption.

In cases of a *sluggish liver,* the drug has been used in small, oft-repeated doses (1/10 gr.–0.006 gm.) to advantage. No remedy is so useful as calomel in the condition known as "*biliousness,*" which is characterized by a thickly coated tongue, fetid breath, heavy urine, headache, and depression of spirits. In these cases 1/6 gr. (0.01 gm.) may be given every fifteen or twenty minutes until 1 gr. (0.06 gm.) has been taken. If the bowels do not move freely, it is well to follow the mercurial with a saline cathartic (Epsom salts or a Seidlitz powder).

Incompatibles.—Calomel is incompatible with hydrochloric acid, chlorids, chlorates, iodids, bromids, and lime-water, as well as with alkalies, alkaline carbonates, iron, lead, and copper.

HYDRARGYRI CHLORIDUM CORROSIVUM—U. S. P.

(Mercuric Chlorid; Mercury Bichlorid; Corrosive Sublimate; $HgCl_2$.)

Mercuric chlorid might well have been discussed under the heading of **Disinfectants,** as it is for this purpose only that it is used in dental therapeutics; but it was left that it might be considered and discussed here with the other compounds of mercury. It occurs in the form of colorless, odorless crystals or a fine white powder, having an acrid, metallic taste. It is soluble in 13 parts of water and in 3 parts of alcohol. The dose is from 1/100–1/12 gr. (0.0006–0.005 gm.).

Physiologic Action and Therapeutics.—Mercuric chlorid, called usually bichlorid or corrosive sublimate, acts as an antisyphilitic and tonic, as well as an energetic disinfectant. It is for the latter action that it is extensively employed in dental as well as in general therapeutics.

The drug is capable of destroying most bacteria in solutions as dilute as 1:20,000, and their spores in solutions of 1:10,000. Certain germs, however, like the anthrax bacillus, are more resistant to its action, and stronger solutions are necessary for their complete destruction. On the whole, it is the most popular of the disinfectants, and takes first rank with surgeons for use upon the *skin of the patient and the hands of the operator* and *for irrigating infected wounds and cavities.* For the patient's skin and the surgeon's hands, solutions of from 1:1,000 to 1:500 should be employed; for large wounds and cavities, 1:10,000 to 1:5,000; and for small wounds, 1:2,000. The drug is an irritant, and should not be used, even in dilute solutions, on serous membranes.

Mercuric chlorid has three disadvantages as a disinfectant: it is extremely poisonous; it is readily converted into an inert compound (mercury albuminate) in the presence of albuminous matter, and it is destructive to metal instruments. This last drawback is a serious objection in dental therapeutics; for, were it not for this fact, the drug would be an ideal disinfectant for instruments. It is energetic, soluble, and cheap. Tartaric or citric acid may be advantageously combined with bichlorid solutions to prevent the mercuric salt from forming an insoluble albuminate with the albumin in the tissues. Compressed tablets of mercuric chlorid, each containing 7 1/2 gr. (0.5 gm.) with tartaric or citric acid are in common use. One of these tablets dissolved in a pint (480.0 c.c.) of water makes a 1:1,000 solution.

For *sterilizing infected dentin* a 1:500 solution is an excellent remedy. The author suggests keeping the pure drug in papers (chartulæ) each containing 1 gr. (0.06 gm.). By so doing, an approximate 1:500 solution may be conveniently made at any time by dissolving the contents of one paper in one ounce (30.0 c.c.) of distilled water. Ordinary water, containing traces of calcium salts, partially precipitates the bichlorid in the form of mercuric oxid. In applying this solution to the tooth-structure with a pledget of cotton and pliers, the latter should be dried immediately after the application on a clean, aseptic doily, to prevent the action of the mercury upon the instrument.

As a parasiticide, mercury bichlorid is a valuable remedy in *pediculosis pubis* and *ring-worm*. In these affections, 2–4 gr. (0.13–0.26 gm.) to the ounce (30.0 c.c.) of tincture of benzoin make an excellent application.

In *syphilis* the drug may be given in pill or in solution. One-twentieth of a grain (0.003 gm.), gradually increased to 1/12 gr. (0.005 gm.), may be given after meals.

HYDRARGYRI IODIDUM RUBRUM—U. S. P.

(Red Mercuric Iodid; Mercury Biniodid; HgI_2.)

Mercury biniodid occurs as a bright red, amorphous powder, without odor or taste. It is practically insoluble in water, soluble in 116 parts of alcohol, and freely soluble in solutions of potassium iodid. The dose is from 1/50–1/12 gr. (0.0012–0.005 gm.). There is one official preparation:

Liquor Arseni et Hydrargyri Iodidi, U. S. P. (Donovan's Solution; 1 per cent. of each Iodid). *Dose*, 1–5 min.(0.06–0.3 c.c.).

Physiologic Action and Therapeutics.—Mercury biniodid resembles the bichlorid in its action and effects. In the *late secondary stage of syphilis* it may be combined to advantage with potassium iodid. Stevens[1] recommends the following formula: Mercury biniodid, 1 gr. (0.06 gm.); potassium iodid, 3 dr. (12.0 gm.); water, 2 fl. oz. (60.0 c.c.); compound syrup of sarsaparilla, sufficient to make 4 fl. oz. (120.0 c.c.). The dose is a dessertspoonful in water after meals.

Donovan's solution is given with benefit in medicinal doses as an alterative in *chronic rheumatism, tuberculosis adenitis, tertiary syphilis,* and during *convalescence* in many *exhaustive diseases.*

HYDRARGYRI IODIDUM FLAVUM—U. S. P.

(Yellow Mercurous Iodid; Mercury Protiodid; Green Mercury Iodid; HgI.)

Mercury protiodid occurs as a yellow, amorphous powder. It is insoluble and without odor or taste. The dose is from 1/10–1/2 gr. (0.006–0.03 gm.).

Physiologic Action and Therapeutics.—Mercury protiodid, being an *ous* compound is far less irritant than the bichlorid or biniodid. It is considered the best compound of mercury for use in *syphilis,* and should be given in pills or capsules to which a little opium may be added in case colic or diarrhea is induced by its ingestion.

Mercurol (Mercury Nucleinate) is an organic compound of mercury with nucleinic acid from yeast. It contains 10 per cent. of metallic mercury, and occurs as a brownish-white powder; soluble in water (warm water), insoluble in alcohol. The dose is from 1/2–2 gr. (0.03-0.13 gm.).

The drug does not coagulate albumin; it has marked bactericidal power, and possesses the pharmacologic action of the soluble compounds of mercury. It is recommended as a local antiseptic and as an antisyphilitic remedy.

Sublamin (Mercuric Sulphate-ethylene-diamin; $HgSO_4.2C_2H_4(NH_2)_2.2H_2O$).—This compound is composed of one molecule of mercuric sulphate and two molecules of ethylenediamin (a compound of ethylene and ammonia). It contains about 44 per cent. of metallic mercury, and occurs in white needles, odorless, but possessing a very disagreeable taste; readily soluble in water and in 10 parts of glycerin, sparingly soluble in alcohol. It is only used externally as a dis-

[1] Modern Materia Medica and Therapeutics.

infectant, similar to mercuric chlorid, over which it has the advantage of being nonirritating, more penetrating, and readily soluble. A 1:200 solution is an excellent remedy for the immediate *sterilization of infected dentin.* The drug will attack steel instruments, and the same precautions must be observed here as with mercuric chlorid. It is used in 1:1,000 solution for hand disinfection, etc. By a carefully conducted series of experiments, Mawhinney has shown that the time required for a 1–200 solution to sterilize a broach was two minutes, and he recommends this strength solution for sterilizing steel instruments. The experience of the author with sublamin has proved it to be a good disinfectant, but that it attacks steel instruments immersed in its solution for any length of time.

Incompatibles.—Sublamin is incompatible with sodium chlorid and should not be exposed to air.

ARSENUM.

(Arsenic; As.)

Metallic **arsenic** is not official, for as such it is not employed as a medicine. The chief compound used in therapeutics, especially dental therapeutics, is arsenic trioxid, which has been fully discussed as a devitalizing agent under **Caustics.** Certain salts of arsenous acid (arsenites) and arsenic acid (arsenates) are also used. The following compounds and preparations containing arsenic in combination are official:

Arseni Trioxidum, U. S. P. *Dose,* 1/60–1/20 gr. (0.001–0.003 gm.).
Liquor Acidi Arsenosi, U. S. P. (contains 1 per cent. of Arsenic Trioxid and 5 per cent. of dilute Hydrochloric Acid). *Dose,* 1–5 min. (0.06–0.3 c.c.).
Liquor Potassii Arsenitis, U. S. P. (Fowler's Solution; contains the equivalent of 1 per cent. of Arsenic Trioxid and 3 per cent. of compound tincture of Lavender). *Dose,* 1–5 min. (0.06–0.3 c.c.).
Sodii Arsenas, U. S. P. *Dose,* 1/16–1/8 gr. (0.004–0.008 gm.).
Sodii Arsenas Exsiccatus, U. S. P. *Dose,* 1/30–1/12 gr. (0.002–0.005 gm.).
Liquor Sodii Arsenatis, U. S. P. (Pearson's Solution; contains 1 per cent. of Exsiccated Sodium Arsenate). *Dose,* 1–5 min. (0.06–0.3 c.c.).
Arseni Iodidum, U. S. P. *Dose,* 1/30–1/10 gr. (0.002–0.006 gm.).
Liquor Arseni et Hydrargyri Iodidi, U. S. P. (Donovan's Solution). *Dose,* 1–5 min. (0.06–0.3 c.c.).

Physiologic Action and Therapeutics.—The action and uses of arsenic trioxid have been elsewhere considered. Arsenic in therapeutic doses acts as an alterative by favoring nutrition. Just how the action is brought about is not understood.

The drug is used internally in a number of quite diverse pathologic conditions. Its use, however, is purely empirical. It stands next to iron in the treatment of anemia. Fowler's solution, although not curative, is the most efficient remedy in *pernicious anemia*. In *neuralgia* dependent upon anemia, arsenic is valuable. The dose should be gradually increased until symptoms of saturation appear. No general tonic, except cod-liver oil, is so efficacious as arsenic in *pulmonary tuberculosis*. The drug has long been used with reported good results in *diabetes mellitus*. It is an excellent alterative in *pyorrhea alveolaris* associated with chronic *rheumatism* or the *gouty diathesis*. The prolonged use of arsenic (1/100–1/50 gr.—0.0006–0.0012 gm.) has been spoken of in the highest terms in *myocardial degeneration* and *angina pectoris*. In these cases it may be combined advantageously with strychnin, and sometimes also with digitalis (Stevens).

Individuals vary considerably in their susceptibility to the action of arsenic, therefore it is best to begin with small doses of the drug and gradually increase them as occasion demands. The indications of saturation are puffiness under the eyes, especially noticeable in the morning, and looseness of the bowels with colicky pains. For pills arsenic trioxid is generally selected, and for solutions the solution of potassium arsenite (Fowler's solution).

Incompatibles.—Arsenic is incompatible with salts of iron, silver, copper, and ammonium, magnesium, calcium, and tannic acid.

SARSAPARILLA—U. S. P.

Sarsaparilla is the *root* of *Smilax officinalis* and other species of *Smilax*, climbing evergreens growing in swampy forests of Mexico and as far south as the northern portion of Brazil. It contains several glycosids—*parillin*, *saponin*, and *sarsa-saponin*. The dose is from 30–60 gr. (2.0–4.0 gm.). The following preparations are official:

Fluidextractum Sarsaparillæ, U. S. P. *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).

Fluidextractum Sarsaparillæ Compositum, U. S. P. *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).

Syrupus Sarsaparillæ Compositus, U. S. P. (contains fluid extract Sarsaparilla, 20; fluid extract Glycyrrhiza, 1.5; fluid extract

Senna, 1.5; Sugar, 6.5; Oil of Sassafras, Oil of Anise, Oil of Gaultheria, of each, 0.02; Water, to make 100). *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Physiologic Action and Therapeutics.—Sarsaparilla owes its pharmacologic activity entirely to the saponins which it contains. The drug has been empirically used as an alterative in *syphilis* and *tuberculosis* for centuries, but its action as such is no longer accepted at the present time, and if it possesses any action at all it is simply that of a very mild nauseant (Sollmann). It is chiefly used in the form of the compound syrup as a pleasant vehicle for potassium iodid, potassium bromid, and certain salts of mercury.

ECHINACEA—Unofficial.

(Cone Flower.)

Echinacea is the *dried root* of *Echinacea angustifolia*, a perennial herb growing in the central and western portions of the United States. A fluid extract may be obtained, the dose of which is from 15–30 min. (1.0–2.0 c.c.). The dose of specific echinacea (tincture) is from 5–30 min. (0.3–2.0 c.c.). *Echafolta* is a purified, assayed form of echinacea. The dose is the same. Externally or for surgical purposes, it is considered greatly superior to any other preparation of echinacea, and is prescribed for the same conditions.

Echinacea was known to the Indians as a cure for snake poison. The experiments with the drug have been confined almost entirely to the eclectic school of medicine, and remarkable properties, almost bordering on the miraculous, are ascribed to it.

Physiologic Action.—Applied to the mucous membrane, a warm and tingling sensation is at once experienced. It is similar to that of aconite, without the sedative effect. The sensation persists for some time, even though the throat is gargled, and the agent entirely removed. The drug actively promotes the flow of saliva, and if swallow the warmth and tingling extends down the esophagus to the stomach, but no further unpleasant influence is observed. In a short time diaphoresis is observed, and the continuation of the remedy stimulates the kidneys to increased action. All of the glandular organs seem to respond to its stimulating influence, and their functional activity is increased. The stomach is improved in its function, the appetite increases, the food is more perfectly digested, the bowels operate better, and absorption, assimilation, and general nutrition are materially improved. It encourages secretion and excretion, prevent-

ing further autointoxication, and quickly correcting the influence in the system of any that has occurred. It stimulates retrograde metabolism, or tissue waste, more markedly than any other single remedy known.

There are but few subjective symptoms from large doses of the drug. It is apparently nontoxic, and, to any unpleasant extent, non-irritant. It has a marked effect upon the nervous system, but its action here has not yet been determined (Ellingwood).

Therapeutics.—Hewitt, Cahill, and others have recommended the drug in dental therapeutics. Some enthusiasts go so far as to recommend the use of the drug in almost every disease to which the body is heir.

The drug has been used in *acute alveolar abscess* to prevent the formation of pus, or after pus-formation to hasten its evacuation. In *septicemia* (blood-poisoning), it is claimed to be almost a specific. In *ulcerative stomatitis, sore throat or mouth* of any character, the local application of echafolta is prompt and effectual.

CALX SULPHURATA—U. S. P.

(Sulphurated Calcium; Crude Calcium Sulphid.)

Sulphurated calcium is a mixture containing at least 60 per cent. of calcium sulphid, together with calcium sulphate and varying proportions of carbon. It occurs as a pale gray powder, having a nauseating, alkaline taste and a faint odor of hydrogen sulphid. It is but slightly soluble in water and insoluble in alcohol. Exposure to air causes gradual decomposition. The dose is from 1/10–1/2 gr. (0.006–0.03 gm.), in pills, tablets, or capsules.

Physiologic Action and Therapeutics.—The action of calcium sulphid is not well understood. Its power of *preventing and arresting suppuration* was first mentioned by Ringer. It has been found especially useful in *boils* and *carbuncles*. Excellent results are obtained in *follicular tonsillitis* and *quinsy* by giving small doses (1/20 gr.–0.003 gm.) at short intervals. Harlan recommended giving the drug in doses of 1/10 gr. (0.006 gm.), at short intervals, in *acute alveolar abscess* and other *suppurative conditions*, claiming that it prevented the formation of pus, if given early enough, or, if too late for this, that the agent hastened the evacuation of the pus. Only fresh preparations should be employed on account of the liability of the drug to deteriorate.

AURI ET SODII CHLORIDUM—U. S. P.

(Gold and Sodium Chlorid; $AuCl_3 + NaCl$.)

This preparation is a mixture of equal parts, by weight, of dry gold chlorid and sodium chlorid. It is an orange-yellow powder, deliquescent, and of a saline and metallic taste; freely soluble in water. The dose is from 1/20–1/4 gr. (0.003–0.016 gm.), in pill.

Physiologic Action and Therapeutics.—Gold and sodium chlorid is supposed to act as an alterative, tonic, and stimulant to the digestive system. It has been recommended in a number of diseases where an alterative and tonic effect is desired, but it is of doubtful value. Solutions of gold chlorid have been recommended by Ames with which to cauterize *exposed sensitive cementum*, claiming its effect is nearly equal to that of silver nitrate without the discoloration.

DIGESTANTS.

The mouth and the stomach are intimately connected and closely related; so much so that pathologic conditions in one often predispose to disease in the other. It is therefore important that the dentist be familiar with the action and uses of certain agents which materially assist in the digestion of food. Those not discussed under other headings will here be considered. They are:

Pepsin.	Malt.
Pancreatin.	Papain.

PEPSINUM—U. S. P.

(Pepsin.)

Pepsin is a proteolytic ferment or enzyme obtained from the glandular layer of *fresh stomachs* from healthy pigs. It occurs as a yellowish-white, amorphous powder, or thin, pale yellow scales, having a faint odor and a slightly acidulous or saline taste. It is soluble in 50 parts of water, more so in water acidulated with hydrochloric acid, and insoluble in alcohol. The Pharmacopeia of the United States requires the drug to be capable of digesting not less than 3,000 times its weight of freshly coagulated and disintegrated egg albumin. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—Pepsin is an excellent digestive, being a normal constituent of the gastric juice, and in the presence of hydrochloric acid (a natural acid of the stomach) it digests the proteid elements of the food, converting these insoluble substances into albumoses, and finally into soluble peptones. The

drug is given in cases where there is a lessened secretion of gastric juice, as in *atonic dyspepsia, cancer of the stomach,* and *gastric ulcer.* Many organic acids, alcohol, and alkalies impair the proteolytic action of pepsin.

PANCREATINUM—U. S. P.

(Pancreatin.)

Pancreatin is a mixture of enzymes naturally existing in the *pancreas* of warm-blooded animals, and is obtained from the fresh pancreas of the hog or the ox. It consists principally of *amylopsin, myopsin, trypsin,* and *steapsin.* To be up to the official standard it should be capable of converting not less than 25 times its weight of starch into water-soluble substance (dextrose). It occurs as a cream-colored powder, slowly but not completely soluble in water, insoluble in alcohol. The dose is from 5–20 gr. (0.3–1.3 gm.).

Physiologic Action and Therapeutics.—The action of pancreatin is due to the active enzymes which it contains, of which trypsin digests proteids, amylopsin acts upon starches, and steapsin emulsifies fats and oils, resolving them into fatty acids and glycerin. The drug, like pepsin, is used as an artificial digestant in *certain disorders of the stomach* wherein digestion is impaired.

MALTUM—U. S. P.

(Malt.)

Malt is the *grain* of barley, *Hordeum distichon,* partially germinated artificially, and then dried. The extract is official:

Extractum Malti, U. S. P. *Dose,* 4 fl. dr. (15.0 c.c.).
Fluidextractum Malti, N. F. (contains 25 per cent. vol. alcohol). *Dose,* 2 fl. dr. (8.0 c.c.).

If the extract of malt is prepared according to the process of the United States Pharmacopeia, the fresh preparation will contain *diastase,* an efficient ferment and capable of converting starch into dextrose. The diastatic power rapidly deteriorates on keeping. The extracts of malt are extensively used as digestants and as general tonics, but their value is more or less questionable, probably on account of the difficulty of obtaining the preparation fresh and properly prepared. Heat above 57° C. (135° F.) destroys the diastase.

PAPAYOTIN—Unofficial.

(Papain; Papoid; Caroid.)

Papain is a natural *albuminous ferment* obtained from *Carica papaya*, the papaw tree, growing in the tropics. It occurs as a grayish-white, amorphous powder, without odor or taste. It is soluble in water and glycerin, but insoluble in alcohol and ether. The dose is from 5–10 gr. (0.3–0.6 gm.).

Physiologic Action and Therapeutics.—It is claimed that papain will convert proteids into peptones, starch into maltose, and emulsify fats; and that although it will act in neutral or acid solutions, it is most active in solutions of an alkaline reaction (Stevens). Harlan introduced the drug in dental therapeutics for *digesting pulp tissue* after devitalization. He suggested making a paste with glycerin, acidulating with one or two minims of a 1:500 solution of hydrochloric acid. The pulp was devitalized in the usual way, and this paste sealed in contact with the dead tissue for one or two weeks, when the tissue was supposed to be liquefied. Clinical experience with the drug in dental, as well as in general therapeutics, proves it of doubtful value.

CATHARTICS.

Cathartics have been elsewhere defined as agents which produce evacuation of the bowels. The drugs having this property are classified according to the intensity of their action and the character of the stool thus produced. Those that are mild in action and produce a nearly normal stool are called *laxatives*. Those more powerful, usually producing more copious stools are termed *purgatives*. Those which produce a watery evacuation of the bowels are called *hydragogues*. Those which gripe, having a violent action, and in overdoses produce symptoms of acute enteritis are termed *drastics*.

The chief laxatives are:

Cascara Sagrada.	Figs.
Tamarind.	Prunes.
Manna.	Honey.

The chief purgatives are:

Aloes.	Rhubarb.
Senna.	Calomel.*
Castor Oil.	Blue Mass.*
Sulphur.	

The principal hydragogues are:

Magnesium Sulphate. Sodium Phosphate.
Sodium Sulphate. Magnesium Citrate.
Potassium and Sodium Tartrate.

The main drastics are:

Croton Oil. Gamboge.
Colocynth. Jalap.
Podophyllum.

RHAMNUS PURSHIANA—U. S. P.

(Cascara Sagrada; Chittem Bark.)

Cascara sagrada is the *dried bark* of *Rhamnus purshiana*, a small tree growing along the Pacific coast of North America. It contains a crystalline glucosid, *purshianin*, that is several times as active as the crude drug. The dose of cascara sagrada bark is from 30–60 gr. (2.0–4.0 gm.). The following preparations are official:

Fluidextractum Rhamnus Purshianæ, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Fluidextractum Rhamnus Purshianæ Aramaticum, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Extractum Rhamnus Purshianæ, U. S. P. *Dose*, 2–8 gr. (0.13–0.5 gm.).

Physiologic Action and Therapeutics.—Cascara sagrada is a peculiarly efficient laxative. Its action is somewhat slow and is seldom accompanied with irritation or unpleasant symptoms. It is used exclusively as a tonic laxative, and in *habitual constipation* it is a reliable remedy. The drug possesses a distinct advantage over many cathartics in not readily losing its effect when frequently taken; in fact, in most cases the dose can be diminished gradually, and this is usually the most satisfactory way of administering the remedy. On account of the unpleasant bitter taste the aromatic fluid extract is the best preparation to use.

TAMARINDUS—U. S. P.

(Tamarind.)

Tamarind is the *preserved pulp* of the *fruit* of *Tamarindus indica*, a large tree indigenous to Africa and cultivated in the West Indies. It is a gentle laxative about equal in power to the fig and prune. Its action is due chiefly to the potassium salts of tartaric, citric, malic, and acetic acids, of which it contains from 8–12 per cent. The dose is

from 1–8 dr. (4.0–32.0 gm.). It is a constituent of the only official confection of senna.

MANNA—U. S. P.

Manna is a *concrete saccharine exudation* from *Fraxinus ornus*, a small native tree of Sicily and other Mediterranean islands. Its chief constituent is *mannite* (50–80 per cent.) a sweet crystalline principle, soluble in water. It acts as a mild laxative in doses of 1–2 oz. (32.0–64.0 gm.). It is usually given in combination with other cathartics, and is a constituent of the compound infusion of senna.

FICUS—U. S. P.
(Fig.)

Fig is the *dried fruit* of *Ficus carica*, a native tree of the shores of Levant, but cultivated in tropical countries. It contains about 62 per cent. of grape-sugar, also gum, fat, etc. It acts as a demulcent and laxative, and is a constituent of the official confection of senna. Figs are chiefly used as an article of diet in *habitual constipation.*

PRUNUM—U. S. P.
(Prune.)

Prune is the *dried fruit* of *Prunus domestica*, the plum tree, indigenous to western Asia, but cultivated in most temperate countries. It contains sugar, pectin, albumin, malic acid, and salts. Prunes are laxative and nutritious, and are freely used as food and sweetmeat. Stewed prunes are an excellent remedy for *constipation* in children. They are a constituent of the confection of senna.

MEL—U. S. P.
(Honey.)

Honey is a *saccharine secretion* deposited in the honey-comb by *Apis mellifica*, the honey-bee. It is a strong aqueous solution of several sugars (cane- and grape-sugar, levulose) with wax pollen, coloring and odorous matters, etc. Honey is often adulterated with starch and glucose. The dose is indefinite. Clarified honey is official (*Mel Despumatum*, U. S. P.), and is an ingredient of confection of senna and of the official honey of rose (*Mel Rosæ*, U. S. P.). Honey is a laxative, nutritive, and emollient. It is used chiefly as an emollient in *diseases of the throat* to relieve *dryness, pain, cough, and dysphagia*, and also as a

pleasant vehicle for certain nauseous drugs. Honey of rose is slightly astringent, and is used in gargles, sprays, or washes for *inflammatory* and *ulcerating conditions* of the mucous membrane of the mouth, throat, and nasal passages. The wax obtained from the honey-comb is a useful material in dental practice.

ALOE—U. S. P.

(Aloes.)

Aloes is the inspissated *juice* obtained from the *leaves* of several species of genus *Aloe*, a familiar example of which is the American century plant. It grows abundantly in nearly all hot, dry countries. Two varieties were formerly recognized by the United States Pharmacopeia (1890): Barbadoes aloes (*Aloe barbadensis*), obtained from *Aloe vera*, and Socotrine aloes (*Aloe socotrina*), obtained from *Aloe perryi*. The chief constituent is *aloin*, also official, a neutral crystalline principle, and from which is obtained *emodin*, a glucosid to which the purgative property of the drug is doubtless due. Emodin is also found in senna and rhubarb. The dose of aloes is from 1–10 gr. (0.065–0.65 gm.). The following preparations are official:

Aloninum, U. S. P. *Dose*, 1/4–2 gr. (0.016–0.13 gm.).
Aloe Purificatum, U. S. P. *Dose*, 1–10 gr. (0.065–0.65 gm.).
Tinctura Aloes, U. S. P. *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).
Tinctura Aloes et Myrrhæ, U. S. P. (contains 10 per cent. of each, with Licorice). *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).
Pilulæ Aloes, U. S. P. (contains about 2 gr.–0.13 gm.). *Dose*, 1–5 pills.
Pilulæ Aloes et Asafœtidæ, U. S. P. (contains about 1 1/3 gr.–0.08 gm. of each). *Dose*, 1–5 pills.
Pilulæ Aloes et Ferri, U. S. P. (contains about 1 gr.–0.065 gm.–each of Aloes and Ferrous Sulphate). *Dose*, 1–3 pills.
Pilulæ Aloes et Mastiches, U. S. P. (Lady Webster's pills; contains about 2 gr. 0.13 gm. of Aloes, with Mastich and Red Rose). *Dose*, 1–5 pills.
Pilulæ Aloes et Myrrhæ, U. S. P. (contains Aloes, 2 gr.–0.13 gm.; Myrrh, 1 gr.–0.06 gm.). *Dose*, 1–4 pills.
Pilulæ Rhei Compositæ, U. S. P. (contains Aloes, 1 1/2 gr.–0.1 gm.; Rhubarb, 2 gr.–0.13 gm.; Myrrh and Oil of Peppermint). *Dose*, 1–5 pills.

The drug enters into other official preparations, as compound extract of colocynth, compound tincture of benzoin, compound cathartic pills, and other vegetable cathartic pills.

Physiologic Action and Therapeutics.—Aloes is a rather slowly acting but effective purgative. It will be noticed from the list of prep-

arations, that aloes is rarely used singly as a cathartic. In *simple, persistent constipation*, it may be combined advantageously with other drugs, nux vomica, ipecac, rhubarb, or podophyllum. Pills of aloes and iron are often given with benefit in *chlorosis* with constipation. The liquid preparations have a disagreeable taste which is difficult to mask and are rarely given. The pill is the popular form of administering the drug.

SENNA—U. S. P.

Senna is the *leaflets* of *Cassia acutifolia* and *Cassia angustifolia*, small shrubs growing, respectively, in Africa and India. It contains chiefly an active acid glucosid, *cathartin* or *cathartinic acid*, also *emodin*. The dose is from 1–3 dr. (4.0–12.0 gm.). The following preparations are official:

Fluidextractum Sennæ, U. S. P. *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).

Syrupus Sennæ, U. S. P. (25 per cent.). *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Infusum Sennæ Compositum, U. S. P. (Black Draft: Senna, 6; Fennel, 2; Manna, 12; Epsom Salts, 12). *Dose*, 1–4 fl. oz. (30.0–120.0 c.c.).

Confectio Sennæ, U. S. P. (10 per cent., with Cassia Fistula, Tamarind, Prune, Fig, Sugar, and Coriander Oil). *Dose*, 1–2 dr. (4.0–8.0 gm.).

Pulvis Glycyrrhizæ Compositus, U. S. P. (18 per cent. of Senna, with Licorice, Sulphur, Sugar, and Fennel Oil). *Dose*, 1/2–2 dr. (2.0–8.0 gm.).

Extract of senna (1.5 per cent.) is a constituent of compound syrups of sarsaparilla.

Physiologic Action and Therapeutics.—Senna acts energetically as a purgative. Its action is more irritating than that of rhubarb and more prompt and powerful than that of aloes. It is one of the best vegetable purgatives, and its effect is certain and reliable in *simple, acute constipation*. In *habitual costiveness*, compound licorice powder is a popular household remedy. It is given at bedtime in about a teaspoonful dose, governed by the age of the patient.

OLEUM RICINI—U. S. P.
(Castor Oil.)

Castor oil is a fixed oil expressed from the *seed* of *Ricinus communis*, a plant indigenous to India, but cultivated in many other temperate countries. It occurs as a pale yellow, viscid oil, having a

faint odor and a slightly acrid, offensive taste. It is freely soluble in alcohol. It contains the glycerid of ricinoleic acid, called *ricinolein*, and to which the purgative property of the drug is due. The dose of castor oil is from 1 fl. dr.–1 fl. oz. (4.0–30.0 c.c.), governed by the age of the patient.

Physiologic Action and Therapeutics.—Castor oil is a mild but thorough purgative. Stevens[1] states that while its fate in the body has not been definitely determined, it is probable that it escapes from the stomach unchanged, and that in the presence of the alkaline juices of the intestines saponification occurs with the liberation of ricinoleic acid, which is subsequently converted into ricinoleates. The latter induce catharsis by stimulating the muscular coat of the bowel, and are probably absorbed, since the oil is known to impart its purgative properties to the milk when given to nursing women.

Castor oil has long been a household remedy to remove irritant material from the bowel in the beginning of *acute inflammatory diarrhea*, especially in children. It is not a suitable remedy for habitual constipation, as is generally supposed by the laity. The drug is a desirable constituent of many lotions, used on the scalp for *dandruff*, etc., owing to its solubility in alcohol.

Patrick, Moyer, and other neurologists highly recommend large doses of castor oil in *tic douloureux*. Smaller doses are first administered, and gradually increased until large quantities may be taken daily without inducing catharsis.

The main objection to castor oil as a therapeutic agent is its disagreeable taste. Many substances have been suggested to overcome this objection, among which may be mentioned the oils of peppermint, gaultheria, and cinnamon. A pleasant combination follows:

> Castor Oil, 8 oz. (240.0 c.c.); Oil of Peppermint, 5 min. (0.3 c.c.); Saccharin, 2 gr. (0.13 gm.); and Alcohol, 1 dr. (4.0 c.c.). The Oil of Peppermint and Saccharin should first be dissolved in Alcohol and then added to the Castor Oil. The usual dose may be given.

Castor Oil may also be given in flexible capsules.

RHEUM—U. S. P.

(Rhubarb.)

Rhubarb is the *root* of *Rheum officinale*, a perennial herb resembling garden rhubarb, but of larger growth, and a native of China, Thibet, and other Asiatic countries. It contains *chrysophanic acid*,

[1] Modern Materia Medica and Therapeutics.

emodin, *tannic acid*, and several resinous principles. It is to emodin and possibly some of the resinous principles that rhubarb owes its purgative properties, for chrysophanic acid has no purgative action and tannic acid is an astringent. The dose of rhubarb is from 5–30 gr. (0.3–2.0 gm.). The following preparations are official:

Tinctura Rhei, U. S. P. (10 per cent., with Cardamom). *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Tinctura Rhei Aromatica, U. S. P. (20 per cent., with Aromatics). *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
Tinctura Rhei Dulcis, U. S. P. (10 per cent., with Licorice, Anise, and Cardamom). *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Fluidextractum Rhei, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Extractum Rhei, U. S. P. *Dose*, 5–10 gr. (0.3–0.6 gm.)
Mistura Rhei et Sodæ, U. S. P. (15 per cent., with Sodium Bicarbonate, fluid extract of Ipecac, and spirit of Peppermint). *Dose*, 1/2–2 fl. dr. (2.0–8.0 c.c.).
Syrupus Rhei, U. S. P. (10 per cent. of the fluid extract). *Dose*, 1–6 fl. dr. (4.0–22.5 c.c.).
Syrupus Rhei Aromaticus, U. S. P. (15 per cent. of aromatic tincture and spiced syrup of Rhubarb). *Dose*, 1–6 fl. dr. (4.0–22.5 c.c.).
Pulvis Rhei Compositus, U. S. P. (Gregory's Powder: Rhubarb, 25; Magnesia, 65; Ginger, 10). *Dose*, 20–60 gr. (1.3–4.0 gm.).
Pilulæ Rhei, U. S. P. (3 gr.–0.2 gm. each). *Dose*, 1–5 pills.
Pilulæ Rhei Compositæ, U. S. P. *Dose*, 1–5 pills.

Physiologic Action and Therapeutics.—Rhubarb acts, in appropriate doses, as a purgative and stomachic. As a secondary effect, however, it frequently causes constipation, due to the tannic acid it contains. Doses of from 1–3 gr. (0.06–0.2 gm.) often produce no cathartic action, but its effect upon the stomach is that of a mild astringent and tonic.

As an agent for removing irritant material from the bowel in the beginning of *acute inflammatory diarrhea*, especially with children, rhubarb is highly efficient. To check *diarrhea in cholera morbus* the following has long been a popular remedy: tincture of rhubarb, tincture of capsicum, tincture of opium, spirit of camphor, and spirit of peppermint—an equal quantity of each. The dose is from 15–30 min. (1.0–2.0 c.c.), in water.

SULPHUR.

(S.)

The element **sulphur** is recognized by the United States Pharmacopeia in three forms:

Sulphur Sublimatum—U. S. P. (Sublimed Sulphur; Flowers of Sulphur).—This occurs as a fine yellow powder, having a slightly characteristic odor and a faintly acid taste. It is insoluble in water, partially soluble in absolute alcohol, ether, and chloroform. The dose is from 10–120 gr. (0.6–8.0 gm.).

Sulphur Lotum—U. S. P. (Washed Sulphur).—This form of sulphur is prepared by digesting sublimed sulphur for three days in weak ammonia water, and then washing. It enters into two official preparations:

Unguentum Sulphuris, U. S. P. (15 per cent.).
Pulvis Glycyrrhizæ Compositus, U. S. P. (8 per cent.) Also,
Unguentum Sulphuris Compositum, N. F.

Sulphur Præcipitatum—U. S. P. (Precipitated Sulphur; Milk of Sulphur).—This is a fine, almost white powder, without odor or taste. It is prepared by precipitation from calcium sulphid solutions with diluted hydrochloric acid. The dose is from 10–120 gr. (0.6–8.0 gm.).

Physiologic Action and Therapeutics.—Sulphur acts locally as a stimulant and parasiticide. Internally, it acts as a mild purgative. As a stimulating remedy it has been recommended in *pyorrhea alveolaris* but its use is of doubtful value. It is a reliable remedy, however, in parasitic diseases, like *scabies* (itch) and *ring-worm*. The ointment may be employed. The drug may be given internally, mixed with honey or molasses, as a laxative. When sulphur is burned in the air, sulphur dioxid (SO_2) is formed. This acid-forming oxid (anhydrid) unites with water to form sulphurous acid (H_2SO_3), which latter product is a potent disinfectant and bleaching agent. Kirk recommends a mixture of boric acid and sodium sulphite as a bleaching agent for tooth-structure. The mixture should be placed in the cavity dry, then moistened and hermetically sealed. A reaction is brought about whereby sulphurous acid is formed.

MAGNESII SULPHAS—U. S. P.

(Magnesium Sulphate; Epsom Salt; $MgSO_4.7H_2O$.)

Magnesium sulphate occurs in small, colorless, rhombic prisms or acicular crystals, without odor, and having a cooling, saline, unpleasant, and bitter taste; soluble in 1.5 parts of water, and insoluble in alcohol. The dose is from 1–8 dr. (4.0–32.0 gm.). There is one official preparation:

Magnesii Sulphas Effervescens, U. S. P. (contains Magnesium Sulphate, 500; Sodium Bicarbonate, 403; Tartaric Acid, 211; Citric Acid, 136) *Dose*, 1–8 dr. (4.0–32.0 gm.).

Physiologic Action.—Magnesium sulphate is a typical representative of the class of saline cathartics, all of which produce evacuation of the bowels chiefly by increasing the amount of fluid in the intestine. They differ in their action from vegetable cathartics in that they stimulate peristalsis but feebly. They not only hinder the absorption of fluid taken with the food, but they abstract more fluid directly from the tissues and blood. To understand thoroughly this so-called *salt action*—*i.e.*, the behavior of saline solutions of varying degrees of concentration in relation to the salinity of the blood serum, by which a flow of fluid to or from the blood is determined—it is necessary that we be familiar with certain physical processes, chief among which is that of *osmosis*—the passage of salts through animal membranes, or the force by which fluids are impelled through organic membranes. If, for example, a 10 per cent. solution of common salt is placed in the bottom of a container and water placed in the top, the two liquids being separated by a more or less permeable animal membrane, in a few moments it will be observed that the specific gravity of the two fluids are the same. By the process of osmosis, then, the salt from the solution in the bottom has passed through the membrane, and a 5 per cent. solution of common salt on both sides of the separating medium is the result. A *semipermeable membrane* is one which allows the passage of one sort of molecules (usually the solvent), while impervious to another (usually the dissolved substance). The interposition of such a membrane between salt solutions of varying degrees of concentration introduces very important modifications in the osmotic process, and results in the development of what is termed *osmotic pressure*. The walls of the intestines are only partly semipermeable; *i.e.*, they are partly permeable to salts, though much less readily than to water. If two solutions having the same molecular concentration in dissolved substance (*i.e.*, *equimolecular*) are separated by a semipermeable membrane impermeable to the dissolved substance, it is evident that no change of liquid will occur. Such solutions, having the same specific gravity and, therefore, the same osmotic tension or pressure, are called *isotonic* to each other. In physiologic literature "isotonic" usually means solutions having the same concentration (specific gravity) as blood-serum, and it is in this sense that the term is used in these pages. If one solution has a greater concentration than the other and the separating medium be a partly semipermeable membrane, like the walls of the intestines, water principally will pass from the weaker into the stronger solution until both have the same concentra-

tion. The stronger solution is then called *hyperisotonic;* the weaker, *hypoisotonic.* Both, not being isotonic, are called *anisotonic.*

With this knowledge of salt action we can readily understand how saline cathartics, in normal subjects, act as hydragogues, *i.e.*, produce a watery evacuation of the bowels, and why they are absorbed from the intestine very slowly and in but small quantities, the greater portion escaping from the body in the stools. The action of saline cathartics, therefore, is purely local, which fact is sustained by the further fact that they do not produce catharsis when intravenously injected. When saline cathartics are administered to an anhydremic patient (having a deficient amount of water in the blood) the process of their action is reversed; instead of the blood in the adjacent tissues yielding its water to the intestine, the blood abstracts water from the bowel, the greater portion of the salt is absorbed, and purgation does not ensue. This means that a hypoisotonic solution of the salt must necessarily be administered, otherwise this result would not follow. An isotonic or perhaps a hyperisotonic solution with a normal subject might be hypoisotonic in cases of anhydremia.

Magnesium sulphate in concentrated solution (hyperisotonic), is an active hydragogue cathartic, producing in a few hours a copious watery evacuation of the bowel without much pain or systemic disturbance. Dilute solutions (hypoisotonic) do not produce purgation, but the salt being absorbed in greater quantity, they act as diuretics, increasing the flow of urine.

Therapeutics.—Magnesium sulphate, being practically free from irritant properties, is an excellent cathartic for removing undigested material from the bowel in *acute enteritis* and *colitis* (colic). Stevens speaks favorably of saline cathartics in *chronic constipation*, giving a small dose before breakfast, claiming that they are sometimes more efficacious than vegetable cathartics. While vegetable cathartics are usually given at night on account of their rather slow action, generally causing no inconvenience until morning, saline cathartics act more promptly and powerfully when given before breakfast.

Saline cathartics are especially indicated in *acute alveolar abscess* as they deplete the engorged tissues, preventing stagnation of the blood in the affected part, thus aiding nature materially in preventing the infected tissues from being broken down into pus. A heaping teaspoonful of Epsom salt may be dissolved in a wineglass half full of warm water, having at hand, in another glass, some fresh water. By drinking the fresh water as soon as the concentrated solution is taken, the bitter taste of the drug will scarcely be noticed.

Epsom salt is also used in *phenol poisoning*, and in *acute lead poisoning*. With phenol, the innocuous phenol sulphonate is formed, and with the soluble salts of lead (acetate) an insoluble sulphate.

Incompatibles.—Magnesium sulphate is incompatible with lead acetate (sugar of lead), silver nitrate, alkaline carbonates, and lime-water.

SODII SULPHAS—U. S. P.

(Sodium Sulphate; Glauber's Salt; $Na_2SO_4.10H_2O$.)

Sodium sulphate occurs in large, colorless, transparent prisms or granular crystals, odorless, and having a bitter, saline taste. It is soluble in 2.8 parts of water, and insoluble in alcohol. The dose is from 2–8 dr. (8.0–32.0 gm.).

Physiologic Action and Therapeutics.—Sodium sulphate acts as a powerful hydragogue cathartic, producing large watery stools. Its action is accompanied by considerable griping, because of which Epsom salt has largely superseded the drug. Sodium sulphate enters into the mixture known as artificial Carlsbad salt, which, given in doses of a teaspoonful in a glassful of hot water half an hour before breakfast, makes an efficient mild aperient. The formula follows: sodium sulphate, 5 oz. (160.0 gm.); sodium bicarbonate, 2 oz. (64.0 gm.); sodium chlorid, 1 oz. (32.0 gm.). Both sodium and magnesium sulphates are active ingredients in certain natural mineral waters, like Hunyadi Janos, Carlsbad, etc. These waters may be given in cases of *pyorrhea alveolaris* associated with *rheumatism* or *gout*.

SODII PHOSPHAS—U. S. P.

(Sodium Phosphate; $Na_2HPO_4.12H_2O$.)

Sodium phosphate occurs in large, colorless, prismatic crystals, without odor, but having a cooling, saline taste. It is soluble in 5.5 parts of water, and insoluble in alcohol. The dose is from 1 gr.–4 dr. (0.06–16.0 gm.), depending on the age of the patient. For a young child a small amount only is necessary. The following preparations are official:

Sodii Phosphas Effervescens, U. S. P. *Dose*, 1–8 dr. (4.0–32.0 gm.).

Sodii Phosphas Exsiccatus, U. S. P. *Dose*, 10–60 gr. (0.6–4.0 gm.).

Liquor Sodii Phosphatis Compositus, U. S. P. (each fl. dr. (4.0 c.c.) contains 1 dr. (4.0 gm.) of Sodium Phosphate, with Sodium Nitrate and Citric Acid). *Dose*, 1–3 fl. dr. (4.0–12.0 c.c.).

Physiologic Action and Therapeutics.—The manner of action of sodium phosphate depends upon the quantity administered. In small doses it acts as a laxative; in large doses, as a purgative. Its mild action and agreeable taste especially commend it for children, to whom the proper doses may be given in milk or other liquid food. Stevens speaks favorably of the drug, given in small doses in hot water before breakfast, in *chronic gastric catarrh with constipation*, also in *simple catarrhal jaundice.*

MAGNESII CITRAS—Unofficial.

(Magnesium Citrate; $Mg_3(C_6H_5O_7)_2.14H_2O$.)

Magnesium citrate is obtained by dissolving magnesium carbonate in citric acid. It is a colorless substance, easily soluble in water. It is only official in the form of solution of magnesium citrate.

Liquor Magnesii Citratis, U. S. P *Dose*, 6–12 fl. oz. (180.0–360.0 c.c.).

In cases of *acute alveolar abscess* where it is desired to administer a saline cathartic, this solution is highly efficacious. It is well tolerated by the stomach, and its action is effective. It is somewhat irritating, and should not be administered when there is any inflammation of the gastrointestinal tract. An effervescent salt of magnesium citrate may be obtained from the pharmacies.

POTASSII ET SODII TARTRAS—U. S. P.

(Potassium and Sodium Tartrate; Rochelle Salt; $KNaC_4H_4O_6.4H_2O$.)

Rochelle salt occurs in colorless, transparent, prismatic crystals, or as a white powder, without odor, but having a cooling, saline taste; soluble in about 1 part of water. The dose is from 2–4 dr. (8.0–16.0 gm.). It is an essential constituent of the official compound effervescent powder.

Pulvis Effervescens Compositus, U. S. P. (Seidlitz Powder). *Dose*, 1 powder.

A dose of Seidlitz powder is contained in two different colored papers—one blue, the other white. The *blue paper* contains Potassium and Sodium Tartrate, 120 gr. (8.0 gm.); and Sodium Bicarbonate, 40 gr. (2.6 gm.). The *white paper* contains Tartaric Acid, 35 gr. (2.3 gm.). The contents of each paper should be dissolved separately, the two solutions mixed, and the whole taken while effervescence is taking place.

Physiologic Action and Therapeutics.—Rochelle salt may be given as a hydragogue cathartic in the same classes of cases that magnesium sulphate was recommended. Its administration is more agreeable than the latter, but its action is less active. The carbonic acid evolved during the effervescence of a Seidlitz powder exerts a more or less sedative influence on the stomach, as well as making the solution more palatable. As a mild saline cathartic, especially during the summer season, a dose of Seidlitz powder is highly efficacious.

OLEUM TIGLII—U. S. P.

(Croton Oil.)

Croton oil is a fixed oil expressed from the *seeds* of *Croton tiglium*, a small native tree of China, but extensively cultivated in India and the Philippine Islands. It occurs as a yellowish, viscid oil, having a faint odor and an acrid, burning taste. It contains *croton-oleic acid*, both free and as a glycerid, together with several other inactive fatty acids. The dose of croton oil is from 1/2–2 min. (0.03–0.13 c.c.).

Physiologic Action and Therapeutics.—Croton oil is a violent irritant. When applied, undiluted, to the skin it causes redness and burning, followed by a copious eruption of pustules. When internally administered it acts as a powerful drastic cathartic, causing in one or two hours several copious movements of the bowels, attended with considerable pain, and sometimes with nausea. Large doses produce all the symptoms of a severe gastroenteritis—burning sensation in stomach, pain, etc. On account of the ease with which it may be administered (small quantities being so effectual) the drug is a convenient cathartic to give in cases where the patient can swallow only with difficulty. It may be taken in a small amount of olive oil or in a pill with bread-crumbs as an excipient. The prompt irritant action of croton oil on the bowel makes it a useful revulsant in cases of cerebral congestion; therefore, its effect is advantageous in *uremia*, *apoplexy*, and *acute mania*. In cases like *lead poisoning*, where *obstinate constipation* is a concomitant, the drug is especially useful.

Croton oil may be mixed with some indifferent oil (croton oil, 1 part; olive oil, 7 parts) and used as a dental counterirritant. It has no advantage here, however, over the more generally used counterirritants (iodin, mustard, capsicum, etc.). Stevens speaks favorably of a mixture of croton oil (1 part) and tincture of iodin (2 parts) to be used as a pigment in *neuritis*.

COLYCYNTHIS—U. S. P.

(Colycynth.)

Colycynth is the *fruit* of *Citrullus colocynthis* deprived of its rind. The plant grows in arid places in Asia, Africa, and southern Europe. It contains *colocynthin,* a bitter glucosid, to which its cathartic property is largely due. The dose of colocynth is 1 gr. (0.06 The following preparations are official:

> Extractum Colocynthidis, U. S. P. *Dose,* 2–5 gr. (0.13–0.3 gm.).
> Extractum Colocynthidis Compositum, U. S. P. *Dose,* 5–20 gr. (0.3–1.3 gm.).
> Pilulæ Catharticæ Compositæ, U. S. P. *Dose,* 1–3 pills.
> Pilulæ Catharticæ Vegetabiles, U. S. P. *Dose,* 1–3 pills.

Physiologic Action and Therapeutics.—Colocynth is an energetic drastic cathartic, producing in full doses copious, watery stools, accompanied frequently by griping. In large doses the irritation excites inflammation of the whole alimentary tract, which may prove fatal. The drug is too irritant to be used alone, and is only given in combination with other drugs in cases of *obstinate chronic constipation,* which frequently accompanies old age.

CAMBOGIA—U. S. P.

(Gamboge.)

Gamboge is a *gum-resin* obtained from *Garcinia hanburii,* a laurel-like tree growing in the East Indies. Its active principle is *cambogic acid.* The dose of the drug is from 1/2–2 gr. (0.03–0.13 gm.). It enters into the following official preparation:

> Pilulæ Catharticæ Compositæ, U. S. P. *Dose,* 1–3 pills.

Physiologic Action and Therapeutics.—Gamboge is an active drastic cathartic. In large doses its irritant effect is capable of causing fatal gastroenteritis. It is never used alone, but may be combined with less powerful cathartics and used in *obstinate chronic constipation.*

JALAPA—U. S. P.

(Jalap.)

Jalap is the *tuberous root* of *Ipomœa Jalapa,* a perennial herb growing in Mexico. It contains two glucosids, *jalapin* and *convolvulin,* both of which are active. The dose of jalap is from 5–20 gr. (0.3–1.3 gm.).

Its official preparations follow:

Extractum Jalapæ, U. S. P. *Dose*, 3–10 gr. (0.2–0.6 gm.).
Resina Jalapæ, U. S. P.′ *Dose*, 1–5 gr. (0.06–0.3 gm.).
Pulvis Jalapæ Compositus, U. S. P. (contains Jalap, 35; Potassium Bitartrate, 65). *Dose*, 15–60 gr. (1.0–4.0 gm.).
Pilulæ Cathartæ Compositæ, U. S. P. *Dose*, 1–3 pills.
Pilulæ Catharticæ Vegetabiles, U. S. P. (each pill contains extract of Jalap, 1/2 gr.—0.03 gm.; compound extract of Colocynth, about 1 gr.—0.06 gm.; extract of Hyoscyamus, 1/2 gr.—0.03 gm.; extract of Leptandra, 1/4 gr.—0.015 gm.; extract of Podophyllum, 1/4 gr.—0.015 gm.; and Oil of Peppermint). *Dose*, 1–3 pills.

Physiologic Action and Therapeutics.—The action of jalap is more like that of the hydragogue cathartics than it is of the drastic. It acts gently, producing, within three or four hours, copious, watery stools. Pharmacologists (Stadelmann, and others) claim that the drug has no action in the absence of bile, the latter serving in all probability as a solvent. For removing the water from the tissues in *dropsy* the drug is frequently combined with a saline, as in the official compound powder of jalap. It is not employed alone as a cathartic, but it is an ingredient of both the official compound cathartic pills and official compound vegetable pills, which preparations are frequently given in *habitual constipation.*

PODOPHYLLUM—U. S. P.

(May Apple; Mandrake.)

Podophyllum is the *rhizome* and *rootlets* of *Podophyllum peltatum*, a perennial herb, growing in moist woods of Canada and northern United States. It contains two isomeric glucosids, *podophyllotoxin* and *picropodophyllin*, and also a resin, *podophyllin*, which is official. The dose of podophyllum is from 5–10 gr. (0.3–0.6 gm.). The official preparations are:

Resina Podophylli, U. S. P. *Dose*, 1/8–1/2 gr. (0.008–0.03 gm.).
Fluidextractum Podophylli, U. S. P. *Dose*, 5–20 min. (0.3–1.3 c.c.).
Pilulæ Podophylli, Belladonnæ et Capsici, U. S. P. (each pill contains Podophyllin, 1/4 gr.—0.016 gm.; extract of Belladonna, 1/8 gr.—0.008 gm.; pulv. Capsicum, 1/2 gr.—0.03 gm.; with Acacia and Sugar of Milk). *Dose*, 1–2 pills.

The resin is also a constituent of compound cathartic pills.

Physiologic Action and Therapeutics.—Podophyllum is an

active drastic cathartic. Its action is rather slow, however, compared with most other drastics; it generally requiring from ten to twelve hours for it to produce evacuation of the bowel. The stools are copious and watery, and usually attended with more or less griping pain. The drug is used in *habitual constipation*, associated with so-called *biliousness*. When combined with other cathartic drugs, those should be selected which are also slow in action, like aloes, calomel, etc. The resin is the most reliable preparation and is generally given in the form of pills.

DIURETICS.

Diuretics are agents that increase the flow of urine. They may act indirectly by forcing a greater volume of blood through the kidneys, or directly by stimulating the renal epithelium. A number of them act in both ways. Certain circulatory stimulants also act as diuretics, among which may be mentioned digitalis and caffein; digitalis appears to have no special action on the secreting cells of the kidneys, its effect as a diuretic is almost entirely dependent upon the influence the drug has over the cardiovascular system. Caffein, on the other hand, is a powerful diuretic, acting directly on the renal epithelium, and, in a lesser degree, on the circulation.

The inorganic salts, urea, and other soluble proteids, normally present in the blood, may be regarded as the physiologic stimuli of the secreting cells of the kidneys. Many other substances, not natural components of the blood, increase the secretion of urine by exerting a direct and specific influence on the cells of the glomeruli and convoluted tubes (Stevens).

Diuretics are employed in dental practice principally for the purpose of removing from the blood certain excrementitious matters, which are supposed to be forerunners of pyorrhea alveolaris. The agents used are chiefly the vegetable salts of potassium and lithium, which not only increase the amount of urine excreted, but, being eliminated through the kidney in large part as carbonates, they tend to make the urine alkaline in reaction. Examples follow:

Potassium Bicarbonate	Potassium Chlorate.
Potassium Carbonate.	Potassium Nitrate.
Potassium Citrate.	Lithium Carbonate.
Potassium Acetate.	Lithium Citrate.
Potassium Bitartrate.	Lithium Benzoate.

POTASSII BICARBONAS—U. S. P.

(Potassium Bicarbonate; $KHCO_3$.)

Potassium bicarbonate occurs in colorless prismatic crystals, without odor, but having an unpleasant, saline, alkaline taste; soluble in 3 parts of water, and practically insoluble in alcohol. The dose is from 10–30 gr. (0.6–2.0 gm.). Potassium bicarbonate, though not contained in as such, is used in making the following official solutions:

Liquor Potassii Arsenitis, U. S. P. (Fowler's Solution).
Liquor Potassii Citratis, U. S. P.
Liquor Magnesii Citratis, U. S. P.

POTASSII CARBONAS—U. S. P.

(Potassium Carbonate; K_2CO_3.).

Potassium carbonate occurs in a white, granular, deliquescent powder; freely soluble in water, but insoluble in alcohol. The dose is from 10–30 gr. (0.6–2.0 gm.). The drug is very irritant and rarely used as such internally; from potassium carbonate, however, the following official preparations are made:

Mistura Ferri Composita, U. S. P.
Pilulæ Ferri Carbonatis, U. S. P. (Blaud's Pills).

POTASSII CITRAS—U. S. P.

(Potassium Citrate; $K_3C_6H_5O_7.H_2O$.)

Potassium citrate occurs in transparent, prismatic crystals or white, granular, deliquescent powder, without odor, but having a pleasant saline taste; soluble in 0.5 part of water, but sparingly soluble in alcohol. The dose is from 15–60 gr. (1.0–4.0 gm.). There are two official preparations. They are:

Liquor Potassii Citratis, U. S. P. *Dose*, 1/2–1 fl. oz. (15.0–30.0 c.c.).
Potassii Citras Effervescens, U. S. P. *Dose*, 30–90 gr. (2.0–6.0 gm.).

POTASSII BITARTRAS—U. S. P.

(Potassium Bitartrate; Cream of Tartar; $KHC_4H_4O_6$.)

Cream of tartar occurs in colorless, or slightly opaque, rhombic crystals, or as a white powder, without odor, but having an acidulous taste; soluble in about 200 parts of water, and very sparingly soluble

in alcohol. The dose is from 15–60 gr. (1.0–4.0 gm.). It is a component of the following official preparation:

Pulvis Jalapæ Compositus, U. S. P. *Dose*, 15–60 gr. (1.0–4.0 gm.).

POTASSII ACETAS—U. S. P.

(Potassium Acetate; $KC_2H_3O_2$.)

Potassium acetate occurs in the form of a white powder or crystalline masses, very deliquescent, odorless, and having a pleasant saline taste; soluble in 0.4 part of water and in 2 parts of alcohol. The dose is from 15–60 gr. (1.0–4.0 gm.).

Physiologic Action.—The vegetable salts of potassium act similarly and will, therefore, be discussed here conjointly. The potassium ion is much more physiologically active than is the sodium ion, and as a result the potassium salts, as a rule, are more irritant and depressant than are the corresponding sodium salts. With the vegetable salts of potassium, however, the action of the base is entirely subordinate to that of the acid radical, and a depressant effect is never observed except when administered continuously or in enormous doses. The dominant action of any one of the vegetable salts of potassium is upon the secreting cells of the kidneys, increasing the amount of urine. The mineral salts of the urine, both of potassium and sodium, are increased, but the evidence is not convincing that the vegetable salts of potassium materially assist oxidation in the tissues, and in consequence augment nitrogenous elimination. In large doses they do, however, impart an alkaline reaction to the urine, and in hyperisotonic solution they act as saline cathartics, producing free watery discharges. Potassium bitartrate differs somewhat from the other vegetable salts of this metal in that it resists oxidation in the body, and, therefore, much of it is eliminated unchanged. It is also a more active cathartic.

Therapeutics.—Clinical experience has fully demonstrated that *acute rheumatism* is influenced favorably by the administration of the vegetable salts of potassium; and it is also true that *pyorrhea alveolaris* in rheumatic or gouty subjects is favorably influenced by these salts, but until we have a clearer understanding of the nature of these diseases, it is useless to speculate upon the mode of action of the remedies employed in their treatment. In these cases 10–30 gr. (0.6–2.0 gm.) of the salt may be dissolved in water and administered. The dose should be repeated every three or four hours until the urine becomes

neutral or slightly alkaline. Both the official solution of potassium citrate and the effervescent salt are agreeable preparations to take. Stevens[1] speaks favorably of combining an alkaline salt with a salicylic compound. Salophen may be selected for this purpose, for while it is practically insoluble in water, it is freely soluble in watery solutions of the alkaline salts.

The vegetable salts of potassium are efficient sedative expectorants in the beginning of *acute bronchitis*, especially when the secretion is viscid and scanty.

Incompatibles.—The vegetable salts of potassium are incompatible with acids, mineral salts, and alkaloidal salts.

POTASSII CHLORAS—U. S. P.

Potassium Chlorate; $KClO_3$.)

Potassium chlorate occurs in colorless, crystalline plates, without odor, but having a cooling saline taste; soluble in 16 parts of water, sparing soluble in alcohol. The dose is from 5–20 gr. (0.3–1.3 gm.) There is one official preparation:

> Trochisci Potassii Chloratis, U. S. P. (each contains about 2 1/2 gr.–0.15 gm.) *Dose*, 1–5 troches.

Physiologic Action.—Potassium chlorate, when applied in dilute form to the mucous membrane, acts as a stimulating alterative; in concentrated form it is a decided irritant. The exact manner of its action is not fully understood. It was supposed formerly that the drug, when internally administered, yielded its oxygen to the blood, but recent investigation tends to prove that this theory is erroneous and that fully 90 per cent. passes out of the body unchanged in the urine, though small quantities have been detected in the saliva, tears, and milk of nursing women. In moderate doses, well diluted, its only noticeable effect is to increase the flow of urine.

Poisoning and Treatment.—In excessively large doses potassium chlorate produces toxic symptoms. Its basic radical or potassium ion depresses the circulation and nervous system, while its acid radical or chlorate ion irritates the stomach, intestines, and kidneys. In the *treatment of poisoning* the stomach should be evacuated by emetics or the stomach-pump, followed, as usual, with demulcents. In case of exhaustion, normal salt solution may be subcutaneously injected.

Therapeutics.—In all inflammatory conditions of the mouth and throat, potassium chlorate makes an excellent local application. Ten grains (0.6 gm.) to the ounce (30.0 c.c.) may be used as a wash, gargle,

[1] Modern Materia Medica and Therapeutics.

or spray. In *mercurial stomatitis,* the salt is almost a specific, and may be employed internally as well as locally. It is quite generally believed by medical men that *salivation* is less likely to follow the continuous use of mercury in *secondary syphilis* when a solution of potassium chlorate is simultaneously used as a mouth-wash. Cushney[1] states that the drug may be given internally as a prophylactic to prevent stomatitis when mercury is being prescribed, but that it does not prevent the salivation. Oral prophylaxis and mouth hygiene are considered important factors in the treatment of syphilis to-day.

The drug is used as a constituent of dental pastes which have gained some prominence as a cure for many mouth diseases. The amount of potassium chlorate in these pastes ranges from 10 to 50 per cent., and in this strength should not be applied to the mucous membrane of the mouth, as much harm is likely to follow. Where the drug is indicated, it is far better to confine its use to weak solutions.

Incompatibles.—Potassium chlorate, being rich in oxygen which it readily gives up, makes the drug incompatible with many easily oxidizable substances, like sulphur, phosphorus, pulverized charcoal, tannic acid, sugar, sulphids, hyposulphites, hypophosphites, and ammonium chlorid.

POTASSII NITRAS—U. S. P.

(Potassium Nitrate; Saltpeter; KNO_3.)

Potassium nitrate occurs in colorless, transparent, rhombic prisms or as a crystalline powder, odorless, and having a cooling saline taste; soluble in 3.6 parts of water, sparingly soluble in alcohol. The dose is from 10–30 gr. (0.6–2.0 gm.) in solution, well diluted.

Physiologic Action and Therapeutics.—Except that it is more irritating to the stomach, the action of potassium nitrate in moderate doses, does not differ materially from the vegetable salts of potassium; it increases the secretion of urine through direct action on the renal epithelium. In large doses potassium nitrate is not only more irritating than the vegetable salts, but is markedly more depressant to the heart and nervous system; for here the action of the base (potassium) is not subordinate to that of the acid radical. Toxic doses produce the symptoms of gastroenteritis, muscular weakness, and collapse.

Potassium nitrate is not used in dental therapeutics. It has been employed in *general dropsy,* but it has no greater efficacy than the less irritating vegetable salts. Inhalations of the smoke of burning niter paper, formerly official, sometimes affords relief in *asthma.* Solutions of the drug, called "brine," are useful for preserving meats.

[1] Pharmacology and Therapeutics, or the Action of Drugs.

LITHII CARBONAS—U. S. P.

(Lithium Carbonate; Li_2CO_3.)

Lithium carbonate occurs as a white powder, without odor, but having an alkaline taste; soluble in 75 parts of water and insoluble in alcohol. The dose is from 5–20 gr. (0.3–1.3 gm.).

LITHII CITRAS—U. S. P.

(Lithium Citrate; $Li_3C_6H_5O_7.4H_2O$.)

Lithium citrate occurs as a white, deliquescent powder, without odor, but having a cooling saline taste; soluble in 2 parts of water, insoluble in alcohol. The dose is from 5–30 gr. (0.3–2.0 gm.).

LITHII BENZOAS—U. S. P.

(Lithium Benzoate; $LiC_7H_5O_2$.)

Lithium benzoate occurs in the form of white, shining scales or powder, odorless and of a cooling, sweetish taste. The dose is from 5–30 gr. (0.3–2.0 gm.).

Physiologic Action and Therapeutics.—The action of the vegetable salts of lithium is very similar to that of the corresponding salts of potassium, because the action of the base in both groups is entirely subordinate to that of the acid radical. They increase the quantity of urine and lessen its acidity.

The salts of lithium have been recommended in the treatment of *gout* and the *uric acid diathesis* because it was found that outside of the body lithium united with uric acid to form a more soluble salt than did either potassium or sodium, but since it has been clearly demonstrated that alkaline medication is without influence on the uratic salts present in the blood or tissues, it is doubtful whether the salts of lithium are any more potent in these diseases than are the vegetable salts of potassium (Stevens). On the hypothesis that the concretions in *pyorrhea alveolaris* were precipitated and deposited on the roots of teeth as the blood, supercharged with suboxidized or excrementitious material, slowly passed through the pericemental membrane, lithium salts and the natural mineral waters have been extensively employed in the treatment of this condition. But, as above mentioned, since it is clearly proven that lithium salts are without influence on the urates in the blood or tissues, and since, too, that it has never been clearly demonstrated that the deposits are formed from the source mentioned, it is indeed doubtful whether these salts play any rôle in the eradication of the disease, except to increase the amount of urine. In the case of

the natural waters, the efficacy which they may possess in this disease is probably dependent upon the depurant (purifying) action of the water itself and not upon the small amount of salt they contain. On this basis, the drinking of large quantities of pure, wholesome water in the treatment of this disease is recommended.

DIAPHORETICS.

Diaphoretics are agents which promote the secretion of perspiration. When the action of the remedy is such that the sweat stands in beads upon the surface, it is called a *sudorific*.

The agents employed may act directly by stimulating the special nerve fibers supplying the sweat glands, indirectly by stimulating the sweat centers of the central nervous system from which those fibers originate, or reflexly by irritating peripheral sensory nerves. The activity of the sweat glands is increased by dilatation of the peripheral vessels, external heat, muscular exercise, dyspnea, strong emotion, nausea, and various drugs (Stevens). Diaphoretics are chiefly used for their evacuant, revulsive, and alterative effects, and also to promote absorption. The drugs usually employed for promoting perspiration are:

Pilocarpus.	Liquor Ammonium Acetate.
Spirit of Nitrous Ether.	Opium.*

PILOCARPUS—U. S. P.
(Jaborandi.)

Pilocarpus is the *leaflets* of *Pilocarpus jaborandi* and *Pilocarpus microphyllus*, schrubs growing in South America. It contains three alkaloids—*pilocarpin*, *pilocarpidin*, and *isopilocarpin*—all of which are physiologically active, but pilocarpin is the most active, is present in greater quantity, and yields with acids soluble crystalline salts, of which two are official: *Pilocarpinæ Nitras, U. S. P.*, and *Pilocarpinæ Hydrochloridum*, U. S. P. These salts are most commonly used; the dose of either is from 1/12–1/2 gr (0.005–0.03 gm.). The dose of pilocarpus is from 5–60 gr. (0.3–4.0 gm.). There is one official preparation of the drug.

Fluidextractum Pilocarpi, U. S. P. *Dose*, 10–60 min. (0.6–4.0 c.c.).

Physiologic Action and Therapeutics.—Probably no other single drug exerts the same influence on the secretory glands of the body as pilocarpin. When internally administered, even in small

doses, the sweat and saliva are markedly increased. It also increases, but to a lesser degree, the lacrimal, nasal, bronchial, gastric, intestinal, and renal secretions. The fact that atropin completely suspends the effect of pilocarpin on the secretions has led pharmacologists to believe that the drug acts by stimulating the peripheral fibers of the nerves supplying the various glands.

Pilocarpin is not much used in dental therapeutics. In *acute uremia* large doses 1/6–1/3 gr. (0.01–0.02 gm.) may be used in conjunction with external heat (hot air or hot vapor baths). The drug is sometimes used for its diaphoretic effect in *acute rheumatism* and *acute coryza.*

SPIRITUS ÆTHERIS NITROSI—U. S. P.

(Spirit of Nitrous Ether; Sweet Spirit of Niter.)

Spirit of nitrous ether, commonly called sweet spirit of niter, is an alcoholic solution of ethyl nitrite, containing not less than 4 per cent. of pure ethyl nitrite. It occurs as a clear, volatile, inflammable liquid, having a yellowish or greenish tint, a pleasant ethereal odor, and a sharp, burning taste. It should be kept in well-stoppered bottles away from light. The dose is from 10–120 minims (0.6–8.0 c.c.), depending upon the age of the patient.

Physiologic Action and Therapeutics.—Spirit of nitrous ether acts as a mild diaphoretic, diuretic, and antispasmodic. Its diaphoretic effect is more pronounced than its diuretic effect when the patient is kept well under cover after its administration; the action is reversed when the patient is lightly covered. It appears, therefore, that external heat augments its diaphoretic action.

Sweet spirit of niter is used extensively as an antispasmodic remedy in *convulsions* which frequently occur in children during the *eruptive period of the diciduous teeth.* It is best given in small doses, at frequent intervals, well diluted with water.

LIQUOR AMMONII ACETATIS—U. S. P.

(Solution of Ammonium Acetate; Spirit of Mindererus.)

This is a solution of diluted acetic acid nearly saturated with ammonium carbonate. It should be slightly acid in reaction, contain about 7 per cent. of ammonium acetate, and prepared as wanted. Somewhat like sweet spirit of niter, it acts as a feeble diaphoretic or diuretic according as the patient is kept warm or cool. It is largely used in *mild febrile affections of children* as a vehicle for spirit of nitrous

ether or preparations of aconite. The dose is from 1–4 fl. dr. (4.0–15.0 c.c.).

EMETICS.

Emetics are agents which produce vomiting (emesis). It is supposed that drugs act to produce emesis either by directly affecting the center in the medulla or by indirectly affecting it through irritation of the sensory nerve endings in the stomach. There is little doubt but what the action of apomorphin is a direct one; ipecac and antimony undoubtedly act both directly and indirectly; and all evidence goes to show that zinc sulphate, copper sulphate, alum, mustard, and tepid water act, in the main at least, indirectly.

Emetics may be used for one of four purposes:

1. To expel poisons or undigested food, which is causing pain, headaches, etc., from the stomach. For this purpose the indirect or local emetics are the most reliable, especially in cases of poisoning.

2. To expel foreign bodies, false membranes, or excessive secretion from the respiratory tract; the effort of vomiting often being sufficient to dislodge and remove the membrane or foreign body. For this purpose the direct or systemic emetics should be used.

3. To expel foreign bodies from the esophagus. Direct or systemic emetics are indicated again here.

4. To expel mucus and bile from the gall ducts in catarrhal jaundice. For this purpose the direct or systemic emetics are perhaps the most useful.

Emetics are principally used in dental therapeutics for the immediate expulsion of poisons that may have been swallowed accidentally or otherwise. It should be remembered that for this purpose the local emetics are employed.

The chief emetics are:

Apomorphin.	Copper Sulphate.*
Ipecac.	Alum.*
Tartar Emetic.	Mustard.*
Zinc Sulphate.*	Tepid Water, in quantity.

APOMORPHINÆ HYDROCHLORIDUM—U. S. P.

(Apomorphin Hydrochlorid.)

Apomorphin is an artificial alkaloid obtained from morphin by abstracting a molecule of water. It is official as the hydrochlorid, which occurs in minute, grayish-white, acicular crystals, odorless, and

having a slightly bitter taste; soluble in about 50 parts of water or alcohol. The dose as an emetic is from 1/12–1/6 gr. (0.005–0.01 gm.); as an expectorant, from 1/30–1/20 gr. (0.002–0.003 gm.).

Physiologic Action and Therapeutics.—From five to twenty minutes after ingestion, according to the dose and method of administration of apomorphin, vomiting ensues, being repeated three or four times at intervals of about fifteen minutes. The emesis is preceded and attended by slight nausea, but with moderate depression. The entire action of apomorphin is upon the medulla; it is, therefore, a direct or systemic emetic, being the most powerful and certain we possess; and is used whenever such an emetic is indicated.

IPECACUANHA—U. S. P.

(Ipecac.)

Ipecac is the *root* of *Cephaëlis ipecacuanha*, or *Cephaëlis acuminata*, a perennial shrub growing in Brazil and other South American states. It contains two alkaloids, *emetin* and *cephaëlin*, and, according to some authorities, also *psychrotin*. The dose of the powdered drug as an emetic is from 15–30 gr. (1.0–2.0 gm.); as an expectorant, 1/2–2 gr. (0.03–0.13 gm.).

The following are its official preparations:

Fluidextractum Ipecacuanhæ, U. S. P. *Dose*, as an emetic, 15–30 min. (1.0–2.0 c.c.); as an expectorant, 2–5 min. (0.1–0.3 c.c.).

Syrupus Ipecacuanhæ, U. S. P. *Dose*, as an emetic, 2–4 fl. dr. (8.0–15.0 c.c.); as an expectorant, 10–60 min. (0.6–4.0 c.c.).

Vinum Ipecacuanhæ, U. S. P. *Dose*, as an emetic, 2–4 fl. dr. (8.0–15.0 c.c.); an expectorant, 10–60 min. (0.6–4.0 c.c.).

Tinctura Ipecacuanhæ et Opii, U. S. P. (contains 1 gr.—0.06 gm. each of Powdered Ipecac and Powdered Opium in 10 min.—0.6 c.c.). *Dose*, 5–15 min. (0.3–1.0 c.c.).

Pulvis Ipecacuanhæ et Opii, U. S. P. (Dover's Powder: Ipecac, 1 part; Opium, 1 part; Sugar of Milk, 8 parts). *Dose*, 5–10 gr. (0.3–0.6 gm.).

Pilulæ Laxativæ Compositæ, U. S. P. (each pill contains Ipecac, 1/16 gr.—0.004 gm.; Aloin, 1/5 gr.—0.013 gm.; Strychnin, 1/120 gr.—0.0005 gm.; extract of Belladonna, 1/8 gr.—0.008 gm.; with Licorice and Syrup). *Dose*, 1–3 pills.

Physiologic Action and Therapeutics.—Ipecac is a powerful irritant to the mucous membranes of the respiratory tract when the powdered drug is inhaled. Its prolonged application to the skin produces much irritation, and even vesication, pustulation, and ulceration

often result. The drug is claimed to possess some antiseptic properties. Internally administered in small doses, ipecac acts as a stimulant to the salivary and gastric glands, its action here is not unlike that of the vegetable bitters. In large doses the drug is a powerful irritant and emetic, the emesis in all probability being due to both a local irritation of the peripheral sensory nerve endings in the stomach and some slight action on the medulla itself.

The drug also exerts a favorable influence on the bronchial mucous membrane, acting as a sedative expectorant, and is frequently employed as a component of cough mixtures. Ipecac, though not very prompt in its action, is a safe and reliable emetic. It is especially useful in children, in whom it is extensively used to *expel irritant material from the stomach.*

The drug has been empirically used for a variety of purposes other than that of an emetic and expectorant. It is used as an antiemetic, antidysenteric, diaphoretic, etc.

ANTIMONII ET POTASSII TARTRAS—U. S. P.

(Antimony and Potassium Tartrate; Tartar Emetic; $2K(SbO)C_4H_4O_6.H_2O$.)

Tartar emetic occurs in the form of colorless, transparent crystals or as a white granular powder, odorless, and having a sweetish, metallic taste; soluble in 15.5 parts of water, and practically insoluble in alcohol. The dose as an emetic is from 1/2–1 gr. (0.03–0.06 gm.); as an expectorant, 1/16–1/12 gr. (0.004–0.005 gm.). The official preparations are:

Vinum Antimonii, U. S. P. (contains 2 gr.—0.13 Tartar Emetic to 1 fl. oz.—30 c.c.). *Dose*, as an emetic, 1/2–1 fl. oz. (15.0–30.0 c.c.); as an expectorant, 10–30 min. (0.6–2.0 c.c.).

Syrupus Scillæ Compositus, U. S. P. (contains Tartar Emetic, 2; Squill, Senega, Sugar, and Water to make 1000). *Dose*, 5–60 min. (0.3–4.0 c.c.).

Physiologic Action and Therapeutics.—Tartar emetic is an irritant and acts as an emetic and expectorant. The drug is fast falling into disuse in medical practice, having been displaced largely by other drugs which are more prompt in their action and less depressant. There is little need of the drug in dental therapeutics, it having been considered here because of its past record as an emetic, sedative expectorant, diaphoretic, and counterirritant.

Tepid water in large quantities generally acts as an emetic.

EXPECTORANTS.

Expectorants are drugs which modify the secretion of mucus from the mucous membrane of the air-passages, affect its quantity, and facilitate its expulsion. The exact mode of their action is not well understood. Those that promote secretion and render it less viscid in character, and, therefore, more easily removed, are generally called *sedative expectorants.* Examples of this class are:

Ipecac.*	Tartar Emetic.*
Apomorphin.*	Potassium Citrate.*

Those drugs which stimulate the mucous membrane of the respiratory tract and lessen the quantity of sputum are termed *stimulant expectorants.* The most important are:

Ammonium Chlorid.	Squill.
Eucalyptus (Eucalyptol).*	Benzoic Acid.*

Oil of Myrtle.

AMMONII CHLORIDUM—U. S. P.

(Ammonium Chlorid; Sal Ammoniac; NH_4Cl.)

Ammonium chlorid occurs as a white crystalline powder, odorless, and having a cooling, saline taste; soluble in 2 parts of water and in 50 parts of alcohol. The drug has the peculiar physical property of passing, when heated, directly from the solid to the gaseous state, and on cooling, from the gaseous directly to the solid state. In other words, it differs from most salts in that it cannot be liquefied by heat. The dose is from 5–20 gr. (0.3–1.3 gm.). The following preparation is official:

Trochisci Ammonii Chloridi, U. S. P. (each contains Ammonium Chlorid, 1 1/2 gr.—0.19 gm.; Extract of Licorice, 3 gr.—0.2 gm.; with Tragacanth, Sugar, and Syrup of Tolu). *Dose,* 1–2 troches.

Physiologic Action and Therapeutics.—Administered in moderate doses by the mouth, ammonium chlorid acts chiefly as a stimulant to the mucous membrane of the respiratory tract and perhaps, also, of the stomach and bowel. It increases the quantity and renders less viscid the mucous secretion. The drug for the most part is eliminated in the urine unchanged.

Ammonium chlorid is extensively employed as a stimulant expectorant in *acute bronchial catarrh, subacute and chronic pharyngitis,* etc.

Incompatibles.—The drug is incompatible with alkalies, mineral acids, tartaric acid, and the soluble salts of silver and lead.

SCILLA—U. S. P.
(Squill.)

Squill is the *bulb* of *Urginea maritima*, a perennial herb, growing on the shores of the Mediterranean Sea. It is supposed to contain several active principles, no one of which, when isolated, fully represents the activity of the crude drug. The dose is from 1–3 gr. (0.06–0.2 gm.). The official preparations are:

Acetum Scillæ, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Tinctura Scillæ, U. S. P. *Dose*, 5–20 min. (0.3–1.3 c.c.).
Fluidextractum Scillæ, U. S. P. *Dose*, 1–3 min. (0.06–0.2 c.c.).
Syrupus Scillæ, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
Syrupus Scillæ Compositus, U. S. P. (contains fluid extract of Squill, 8 per cent.; fluid extract of Senega, 8 per cent.; Tartar Emetic, 2 per cent.). *Dose*, 10–60 min. (0.6–4.0 c.c.).

Physiologic Action and Therapeutics.—The action of squill somewhat resembles that of digitalis, though it is much less powerful. It also acts as a stimulant expectorant and a diuretic. The syrup of squill is a common component of cough mixtures.

OLEUM MYRTI—Unofficial.
(Oil of Myrtle; Myrtol.)

Oil of myrtle is a greenish-yellow, volatile oil, distilled from the *leaves* and *flowers* of *Myrtus communis*, the common European myrtle. Its properties are almost identical with those of eucalyptol. The dose is from 3–10 min. (0.2–0.6 c.c.). It may be employed as a stimulant expectorant in cases of *cold in the head*. A few minims may be added to a basin of hot water and the fumes inhaled. It may also be taken internally by placing 2–3 min. (0.13–0.2 c.c.) of the oil on a blank sugar tablet or a piece of loaf-sugar. Harlan recommends the drug for the treatment of *putrescent pulps*, but it is of doubtful value, other remedies for this purpose having completely displaced the essential oils.

SIALOGOGUES.

Sialogogues are drugs or remedies which stimulate the salivary and buccal mucous glands, increasing the secretion and flow of saliva and buccal mucus. There are many diseases and conditions which change the character and flow of the mouth secretions. Among the men who have experimented with mouth secretions in relation to health and disease may be mentioned Black, Miller, Williams, Michaels,

Kirk, Acre, Hinkins, Cook, and others. Michaels claims the saliva to be pathognomonic of certain diseases, the diagnosis being made by physical and chemic examinations of the saliva. Cook has shown that astringent mouth-washes interfere for hours with the action of ptyalin upon starchy food. The mixed saliva is normally alkaline in reaction. The author, collaborating with Hinkins and Cook, spent considerable time investigating the cause of erosion. One point established beyond doubt, which has also been mentioned by other investigators, was that the saliva in typical cases of erosion is *always acid.* Hinkins has repeatedly called attention to the fact that simply holding the mouth open for any length of time, as in dental operations where the rubber dam is used, materially affects the character and flow of saliva. Chewing a piece of clean wood, rubber, and even gum or tobacco augments the flow of saliva, as does also the smell of victuals. Many drugs also produce a sialogogue effect, the most important of which have been discussed under other headings. They are:

Pilocarpus (Jaborandi).*	Potassium Chlorate.*
Mercurials.*	Echafolta.*
Iodin Compounds.*	Tobacco.*
Acetic Acid.*	

To collect saliva for experimental purposes almost any clean substance may be chewed, the mere movements of the jaws stimulate the gland. Another means is to place the tongue on the roof of the mouth and inhale dilute acetic acid through the mouth. This stimulates the secretion especially from the sublingual gland.

The rôle played by the saliva in mouth diseases is by no means settled, and this field offers an excellent opportunity for further investigation to those scientifically inclined.

CARMINATIVES.

Carminatives are drugs that aid in the expulsion of gas from the stomach or intestines. The gas found in the alimentary canal comes from various sources: it may have been swallowed with the food, formed by the action of acid upon the carbonates contained in the food and saliva, or it may be generated through fermentation or putrefaction of the stomach contents; fermentation being the most common cause of abnormal accumulation of gas. Although this class of drugs are chiefly valuable in the expulsion of gas already formed, they also prevent, to a more or less degree, the formation of flatus, for, by quickening the gastric circulation, they doubtless stimulate glandular activity,

thus they act as stomachics by aiding digestion and lessening fermentation. Carminatives are frequently combined with purgative drugs; here they act as *correctives* by modifying or correcting the griping pain which purgatives are likely to induce when given alone.

Most of the drugs belonging to this class are aromatics containing essential oils as their chief active constituent. Alcohol, ether, and chloroform are the exceptions. The principal carminatives are:

Capsicum.*	Cardamom.	Caraway.
Pepper.	Cloves.*	Fennel.
Nutmeg.	Cinnamon.*	Coriander.
Ginger.	Anise.	Mustard.*
Peppermint.*	Allspice.	Alcohol.*
Spearmint.	Sassafras.	Ether.*
	Chloroform.*	

PIPER—U. S. P.

(Black Pepper.)

Black pepper is the *unripe fruit* of *Piper nigrum*, a climbing vine cultivated in the East Indies. It contains a crystalline neutral principle, *piperin*, a volatile oil, and a pungent resin. The dose of ground pepper is from 5–20 gr. (0.3–1.3 gm.).

The preparations follow:

Piperia, U. S. P. *Dose*, 1–5 gr. (0.06–0.3 gm.).
Oleoresina Piperis, U. S. P. *Dose*, 1/2–2 min. (0.03–0.1 c.c.).

Pepper is a carminative and is largely used as a condiment.

MYRISTICA—U. S. P.

(Nutmeg.)

Nutmeg is the *seed* of *Myristica fragrans*, an evergreen tree growing in the Molucca Islands and other East India islands. It contains a volatile oil, to which its aromatic properties are due, also a fixed oil. The dose is from 5–20 gr. (0.3–1.3 gm.). The volatile oil is official.

Oleum Myristicæ, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).

Nutmeg is used as a condiment. It also enters as an aromatic into many of the official aromatic and compound preparations.

Mace is the ground fleshy covering (arillode) of nutmeg. It is used as a condiment.

ZINGIBER—U. S. P.

(Ginger.)

Ginger is the *ground rhizome* of *Zingiber officinale*, a perennial herb growing in the tropical countries. It contains a volatile oil, having the odor of ginger, and a viscid resinous principle, having a hot, pungent taste. The dose is from 5–20 gr. (0.3–1.3 gm.).

The following preparations are official:

Tinctura Zingiberis, U. S. P. *Dose*, 20–60 min. (1.3–4.0 c.c.).
Fluidextractum Zingiberis, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Syrupus Zingiberis, U. S. P. *Dose*, 1/2–4 fl. dr. (2.0–15.0 c.c.).
Oleoresina Zingiberis, U. S. P. *Dose*, 1/2–2 min. (0.03–0.13 c.c.).

Ginger is used as a carminative and as a flavoring agent. It is also a constituent of the official compound powder of rhubarb and aromatic powder.

MENTHA VIRIDIS—U. S. P.

(Spearmint.)

Spearmint is the *leaves* and *tops* of *Mentha spicata*, a perennial herb growing wild in the woods and along the roadsides of Europe and North America. Its official preparations are:

Oleum Menthæ Viridis, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).
Spiritus Menthæ Viridis, U. S. P. *Dose*, 10–30 min. (0.6–2.0 c.c.).
Aqua Menthæ Viridis, U. S. P. *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Therapeutically, spearmint is almost equivalent to peppermint, and is used for practically the same purpose.

CARDAMOMUM—U. S. P.

(Cardamom.)

Cardamom is the *fruit* of *Elettaria repens*, a perennial herb, cultivated in the mountainous portions of India. Its active principle is a volatile oil, of which it contains about 5 per cent. The official preparations are:

Tinctura Cardamomi, U. S. P. *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Tinctura Cardamomi Composita, U. S. P. (contains also Cinnamon, Caraway, Cochineal, and Glycerin). *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).

Pulvis Aromaticus, U. S. P. (Aromatic Powder; contains Cardamom, Ginger, Cinnamon, and Nutmeg). *Dose,* 10–30 gr. (0.6–2.0 gm.).

Cardamom also enters into several of the official aromatic and compound preparations. It is used as a flavoring agent and carminative.

ANISUM—U. S. P.

(Anise.)

Anise is the *small fruit* of *Pimpinella anisum,* a small plant cultivated in southern Europe and North America. It contains a volatile oil, having the characteristic odor of the drug, and a sweetish, aromatic taste. Its preparations follow:

Oleum Anici, U. S. P. *Dose,* 2–5 min. (0.13–0.3 c.c.).
Spiritus Anici, U. S. P. *Dose,* 1–2 fl. dr. (4.0–8.0 c.c.).
Aqua Anici, U. S. P. *Dose,* 2–8 fl. dr. (8.0–30.0 c.c.).

The drug also enters into many of the official aromatic and compound preparations. It is used chiefly as a flavoring agent.

PIMENTA—U. S. P.

(Allspice.)

Allspice is the *nearly ripe fruit* of *Pimenta officinalis,* an evergreen tree growing in the West Indies and South America. It contains a volatile oil, the active constituent of which is *eugenol.* The oil only is official, which is a constituent of spirit myrcia, or bay-rum.

Oleum Pimentæ, U. S. P. *Dose,* 1–5 min. (0.06–0.3 c.c.).

SASSAFRAS—U. S. P.

Sassafras is the *bark* of the *root* of *Sassafras variifolium,* a shrubby tree growing in the woods of eastern and central North America. The pith is also official (*Sassafras medulla, U. S. P.*) It contains an aromatic, fragrant, volatile oil and tannic acid.

The official preparations are:

Oleum Sassafras, U. S. P. *Dose,* 1–5 min. (0.06–0.3 c.c.).
Mucilago Sassafras Medullæ, U. S. P. (2 per cent.). *Dose,* 1–8 fl. dr. (4.0–30.0 c.c.).

Sassafras oil also enters into the official compound fluid extract of sarsaparilla and compound syrup of sarsaparilla. The mucilage is an excellent demulcent in cases of *drug poisoning,* and a tea made by steeping the bark of the root is extensively used by the lay American as a "spring remedy."

CARUM—U. S. P.

(Caraway.)

Caraway is the *fruit* of *Carum carvi*, a native herb of Asia, but cultivated in Europe and North America. Its active constituent is a volatile oil. Caraway is used as a flavoring agent, and as such it enters into the official compound tincture of cardamom and compound spirit of juniper. The oil is official:

Oleum Cari, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.)

FŒNICULUM—U. S. P.

(Fennel.)

Fennel is the *fruit* of *Fœniculum vulgare*, a plant growing chiefly in southern Europe. It contains an aromatic oil. The official preparations are:

Oleum Fœniculi, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).
Aqua Fœniculi, U. S. P. *Dose*, 1–8 fl. dr. (4.0–30.0 c.c.).

As a flavoring agent fennel enters into compound licorice powder, compound spirit of juniper, and compound infusion of senna.

CORIANDRUM—U. S. P.

(Coriander.)

Coriander is the *fruit* of *Coriandrum sativum*, an herb grown in all parts of Europe and the United States. It contains a volatile oil, which is official.

Oleum Coriandri, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).

The oil is used as a flavoring agent, and as such it enters into the confection of senna, syrup of senna, and compound spirit of orange.

FLAVORING AGENTS.

Flavoring agents are used to mask the taste of nauseous drugs, to flavor foods, drinks, etc. The chief flavoring agents are:

Lemon.	Sarsaparilla.*
Orange.	Rose.
Vanilla.	Sugar and Sugar of Milk.
Lavender.	Honey.*

Saccharin.

LIMON.

(Lemon.)

Lemon is the *ripe fruit* of *Citrus limonum*, a tree cultivated in most semitropical countries. The rind contains a volatile oil, and the juice, citric acid. The following preparations are official:

Limonis Cortex, U. S. P. (Fresh Rind).
Limonis Succus, U. S. P. (Juice). *Dose*, 1–4 fl. oz. (30.0–120.0 c.c.).
Tinctura Limonis Corticis, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
Oleum Limonis, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).
Acidum Citricum, U. S. P. *Dose*, 5–20 gr. (0.3–1.3 gm.).
Syrupus Acidi Citrici, U. S. P. (1 per cent.). *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

The oil also enters into other official preparations as a flavoring agent. Lemon juice has been used in *scurvy*, both as a preventive and curative agent. In the form of cold lemonade it makes a pleasant refrigerant drink. Hot lemonade is a useful remedy for *colds*. Both the fresh rind and juice are used extensively as flavoring agents.

AURANTIUM.

(Orange.)

There are two varieties of **orange**: Sweet orange, *Citrus aurantium*, and bitter orange, *Citrus vulgaris*. The following preparations are official:

Aurantii Amari Cortex, U. S. P. *Dose*, 15–30 gr. (1.0–2.0 gm.).
Fluidextractum Aurantii Amari, U. S. P. *Dose*, 1/2–1 fl. dr. (2.0–4.0 c.c.).
Tinctura Aurantii Amari, U. S. P. *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Aqua Aurantii Florum, U. S. P. *Dose*, indefinite.
Aqua Aurantii Florum Fortior, U. S. P.
Syrupus Aurantii Florum, U. S. P. *Dose*, indefinite.
Auranti Dulcis Cortex, U. S. P. *Dose*, 15–30 gr. (1.0–2.0 gm.).
Tinctura Aurantii Dulcis, U. S. P. *Dose*, 1–2 fl. dr. (4.0–8.0 c.c.).
Syrupus Aurantii, U. S. P. *Dose*, indefinite.
Oleum Aurantii Cortex, U. S. P. *Dose*, 1–5 min. (0.06–0.3 c.c.).
Syrupus Aurantii Compositus, U. S. P. *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).
Elixir Aromaticum, U. S. P. *Dose*, 1–4 fl. dr. (4.0–15.0 c.c.).

Both varieties of orange are used almost exclusively as flavoring agents.

VANILLA.

Vanilla is the *fruit* of *Vanilla planifolia,* a perennial climbing plant, native of the West Indies and tropical America. Its characteristic odorous principle is *vanillin.* The tincture is official:

Tinctura Vanillæ, U. S. P. (10 per cent.). *Dose,* a few minims, according to the strength of flavor desired.

Vanilla is employed chiefly as a perfume and as a flavoring agent.

LAVANDULA.

(Lavender.)

Lavender is the *flowers* of *Lavandula officinalis,* a native shrub of southern Europe. It contains a fragrant volatile oil, tannic acid, and resin. The official preparations are:

Oleum Lavandulæ Florum, U. S. P. *Dose,* 1–5 min. (0.06–0.3 c.c.).
Spiritus Lavandulæ, U. S. P. *Dose,* 1/2–1 fl. dr. (2.0–4.0 c.c.).
Tinctura Lavandulæ Composita, U. S. P. *Dose,* 1/2–1 fl. dr. (2.0–4.0 c.c.).

The compound tincture is also an ingredient of Fowler's solution. The preparations of the drug are used only for their agreeable flavor.

ROSA GALLICA—U. S. P.

(Rose.)

Rose is the *dried petals* of *Rosa gallica,* a species of red rose cultivated extensively in western Asia and southern Europe. It contains a volatile oil, tannic acid, sugar, and mucilage. The official oil of rose is distilled from the fresh flowers of the Damascus rose (*Rosa damascena.*) The following are its official preparations:

Fluidextractum Rosæ, U. S. P.
Syrupus Rosæ, U. S. P. (12.5 per cent. of the fluid extract).
Mel Rosæ, U. S. P. (12.5 per cent. of the fluid extract in clarified Honey).
Confectio Rosæ, U. S. P. (Red Rose, 8; Sugar, 64; Honey, 12; Stronger Rose Water, 16).
Oleum Rosæ, U. S. P. (Attar of Rose).
Aqua Rosæ Fortior, U. S. P. (Water saturated with oil of Rose).
Aqua Rosæ, U. S. P. (equal parts of Stronger Rose Water and Distilled Water).

Preparations of rose also enter into several official preparations as flavoring agents. The ointment of rose water (cold cream) makes

an excellent application for the hands and face. A splendid lotion for the hands is: Phenol (95 per cent.) 6 min. (0.36 c.c.); borax, 1/2 dr. (2.0 gm.); rose water, and glycerin, of each 1 1/2 fl oz. (45.0 c.c.).

SACCHARUM—U. S. P. AND SACCHARUM LACTIS—U. S. P.

(Cane-sugar; Sugar and Sugar of Milk; Lactose.)

Cane-sugar is refined from *sugar-cane, Saccharum officinarum,* from various species of *broom-corn, Sorghum,* and from one or more varieties of *sugar-beet, Beta vulgaris.* A saturated solution is official as:

Syrupus, U. S. P. (Simple Syrup).

Sugar enters as a flavoring agent, preservative, vehicle, or excipient into many official compound preparations. Sugar of milk is the sugar obtained from the whey of cow's milk. It is harder, less soluble, and less sweet than ordinary sugar, and is largely used as a diluent for powders, as in Dover's powder.

BENZOSULPHINIDUM—U. S. P

(Benzosulphinid; Saccharin.)

Saccharin is obtained from the *coal-tar* derivative, *toluene.* It occurs in a light, white, crystalline powder, odorless, and possessing 500 times the sweetening power of cane-sugar. It is soluble in 250 parts of water, more so in alcohol or glycerin, and readily soluble in alkaline solutions.

Saccharin is used as a flavoring agent for mouth-washes, tooth-pastes, tooth-powders, etc. Internally, in large doses, it retards digestion and, therefore, metabolism.

REMEDIES OTHER THAN DRUGS.

The object sought in all therapeutics is simply to assist Nature in her efforts to ward off disease and to restore an abnormal to a normal condition. In dental therapeutics this gives to the resourceful dentist a wide range of activity. There are several means of combating disease other than by the use of drugs. Those deserving mention will briefly be discussed here. They are:

Heat.	Electricity.
Cold.	Massage.
Compressed Air.	Suction.
Light.	Suggestion.

HEAT.

Heat is a useful therapeutic agent. It is largely employed locally in dentistry and is applied in both the dry and moist forms. Dry heat is applied by means of hot cloths, bran-bags, water-bags or water-bottles, or superheated dry air. Moist heat may be applied by means of fomentations, poultices, or the hot-water syringe. Hot-water baths are also applicable to certain limited portions of the body, as the feet, and are used for counterirritant purposes. Locally applied, heat allays irritation of the peripheral sensory nerves, dilates the cutaneous vessels, increases perspiration, and, like cold and counterirritation, doubtless exerts a favorable influence on the subjacent structures.

The general application of heat may be obtained by means of the hot-water bath, hot pack, hot-vapor bath, or hot blankets. In the Russian bath steam replaces the hot-dry air of the Turkish bath. The first effects of the general application of heat are free perspiration, resulting from the dilatation of the cutaneous vessels.

Moist external heat is used for a variety of diseases, especially *subacute* and *chronic rheumatism.* Dry external heat may be employed in many cases of *drug poisoning,* one symptom of which is that characteristic cold, clammy sweat.

Moist heat is used locally in *pericementitis, in acute alveolar abscesses* accompanied by pain and swelling, and many other dental conditions. Dry heat is chiefly used in dentistry for *drying tooth-structure* and *obtunding sensitive dentin.* For this purpose many apparatuses have

been devised for heating dry air. Properly shaped wire, for root-canal work, may be heated and used.

Heat is also employed to the extent of actual destruction of tissue in *vesication* and *cauterization*. The thermocautery and galvano-cautery are exceedingly valuable as counterirritant, revulsive, and hemostatic measures.

Thermometric Scale.—For determining the temperature, the Fahrenheit scale is in ordinary use in America and England; the centigrade is used on the European continent; the latter scale is also largely used in the sciences. The freezing-point of water with the Fahrenheit scale is 32° above zero; with the centigrade scale it is at zero. The boiling point of water with the Fahrenheit scale is 212°. This minus the 32° equals 180° above zero. The boiling-point of water with the centigrade scale is 100°. Therefore, stated in terms of proportion: 100° C : 180° F : : 5 : 9, hence the following simple rules for converting the degrees of one scale into the other.

To Convert Degrees of the Fahrenheit Scale into those of Centigrade: If the temperature be above the freezing-point (32°), subtract 32; if it be below the freezing-point, subtract the number from 32, algebraically; then multiply the remainder by 5 and divide by 9.

To Convert Degrees of the Centigrade Scale into those of Fahrenheit: Multiply the number of the former by 9 and divide by 5; if the temperature be above the freezing-point (0°), add 32; if it be below the freezing-point, subtract the result from 32, algebraically.

COLD.

Cold, like heat, may be used either locally or generally as a therapeutic agent. It is the local application of the remedy with which dentists are mostly concerned. It may be locally applied by means of cloths wrung out of iced water, an ice-bag, an ice-poultice, etc. As cold is but a lesser degree of heat, the latter may be abstracted and cold produced by spraying the part with a highly volatile liquid, like ethyl chlorid, ether, etc.

Local applications of cold abstract heat from the part, lessen the sensibility of the peripheral nerve-endings, cause contriction of the blood-vessels traversing the tissues exposed to the cold, and affect, reflexly, the vascularity of the structures subjacent to the site of application.

The general application of cold to the body may be accomplished in several ways: By cold-water bath, cold sponge-bath, cold pack, or the cold douche. When followed by vigorous rubbing with a Turkish

towel, cold bathing exerts a powerful tonic effect. It sharpens the appetite, aids digestion, promotes metabolism, and greatly favors the elimination of waste products.

Cold is employed for a variety of purposes in the treatment of disease. In dentistry it is used as a counterirritant in *acute alveolar abscess*, in *pericementitis*, *neuralgia*, and other conditions. As a refrigerant local anesthetic, cold may be obtained by the use of ether, or combinations containing it, and ethyl chlorid, both used as sprays. In this manner cold is used in *lancing abscesses*, *obtunding sensitive dentin*, *extracting loose teeth, etc.*

COMPRESSED AIR.

Compressed air is one of the most convenient agents in the modern dental office. While in itself it may not be considered a therapeutic agent, except as a vehicle for applying heat or cold, it is, nevertheless, a valuable adjunct to the use of many such agents. For *drying a sensitive cavity*, *clearing away the "chips,"* and *lessening the pain of drilling*, it has no equal (see p. 263). In *treating pyorrhea alveolaris* it serves a useful purpose. By its employment the pocket may be kept dry sufficiently long for the operator to see in many cases whether or not the deposits have been thoroughly removed. It may be used as the force for spraying solutions all through the operation; and when the teeth are scaled and polished the field may be kept dry by the use of compressed air while the astringent remedy is applied. The resourceful dentist will find many uses for the agent.

LIGHT.

Light is a form of energy which has recently been brought forth as having a peculiarly favorable effect upon diseased tissues of the body, and is employed to-day for a variety of purposes in therapeutics, both general and dental. The blue light, lucodescent light, and other forms are used. The mode of action is not well understood. Extravagant claims are being made for the lucodescent light, but it is thought by many that the real virtue lies in the soft penetrating heat produced. It may prove to be a practical means of applying heat which has long been recognized as a therapeutic agent. Reliable evidence has thus far been lacking to prove that the light has an action upon the tissues other than through the heat generated. The blue light has been suggested for *obtunding sensitive dentin*, and is obtained in one way by passing the ray through blue glass. A blue bulb (16 or 32 c. p.) is used on an ordinary electric socket. The room is darkened

and the patient requested to look at the light which is held from six inches to one foot from the eyes. Whether the light acts locally or affects the vision and thus the general nervous system has yet to be determined. The author's experience with light thus far has not been encouraging. It is true, however, that light differs in effect from heat, though both come from the same heated body. This phenomenon is observed in the action of light on certain chemicals; for example, the silver salts undergo a chemic change when exposed to sunlight or luminously hot bodies. For this reason it has been suggested by Black and others to expose the tooth-surface treated with silver nitrate to the sunlight, if possible. The author finds a more practical way of accomplishing the change in the decomposition of the salt by using the small electric mouth-lamp. Light from a small electric mouth-lamp serves almost as a positive means of diagnosing a *dead pulp* in a tooth where the color is practically normal; it also aids materially in confirming the diagnosis of *obscure antrum involvement.*

It is to be hoped that further investigation may be made with light as a therapeutic agent that its action may be better understood, for it seems to possess sufficient merit to justify such investigation.

Rontgen or X-ray.—The Röntgen or X-ray has been employed extensively in both general and dental therapeutics; in dentistry it is largely used for diagnostic purposes. By means of the *skiagraph* (an X-ray picture) the diagnosis of the following conditions may be confirmed:

1. *Fracture of the jaw* and the relation of the fragments.
2. *Fracture and dislocation of the teeth* in the jaw.
3. *Alveolar abscess:* involving more roots than one; in relation to the nasal cavity; in relation to the maxillary antrum (antrum of Highmore).
4. *Impacted and nonerupted teeth;* as to the cause of neuralgic conditions, and in point of treatment, extraction, etc.
5. *Pulp-nodules, pulp-calcification, and secondary dentin.*
6. *Cementosis.*
7. *Foreign bodies in the maxillary antrum.*
8. *Broken broach in tooth-root.*

There are other conditions in dental practice wherein the X-ray aids materially in arriving at a correct diagnosis. Much credit is due to Kells, Price, Shamburg, Lewis, and others for developing skiography in dentistry.

The X-ray treatment has been found extremely valuble in *superficial cancer, lupus vulgaris,* and *acne.* It has also been employed in the treatment of *pyorrhea alveolaris* with varying results. The powerful actinic properties of this modified form of light are illustrated by

the fact that several deaths and many injuries, such as burns, necessitating amputation in some cases, have been traced to the long-continued exposure of the X-ray.

The method devised by Finsen of concentrating rays of either sunlight or electric arc-light has met with more or less success in the treatment of *lupus vulgaris* and other skin diseases, but it has not been utilized in dentistry to any extent.

Radium.—The salts of radium (bromid and chlorid) give out three kinds of rays, known as *alpha*, *beta*, and *gamma* rays. The therapeutic uses of radium rays have been shown to follow practically the same lines as those of the X-ray, but they are generally considered less useful. At the present time the use of radium rays is only in the experimental stage and no positive evidence is at hand to prove their superior value. They require the same careful handling as the X-ray, as they are capable of producing severe burns and even deep-seated ulcers.

ELECTRICITY.

Electricity is used as a therapeutic agent itself, as well as a carrying medium for drugs (cataphoresis), and for purposes of diagnosis and prognosis. Two currents are employed, the *primary* or *galvanic* and the *induced* or *faradic*, the battery furnishing the current being supplied with a *positive* pole, or *anode*, and a *negative* pole, or *cathode*. When the electric current is passed through a muscle it causes contraction of the latter. As a muscle degenerates it gradually loses its electrocontractility, the response to the faradic current disappearing first, while the galvanic current produces contraction for some time longer, until finally no current will produce any effect.

Electricity is used as a muscle and nerve stimulant for a variety of conditions, such as in the so-called idiopathic forms of *neuralgia*, in *neurasthenia*, *hysteria*, etc. In *poisoning by opium and other narcotics* a strong faradic current often affords a means of arousing the patient without increasing the exhaustion or causing any ill effects. In dental therapeutics, perhaps, the greatest use of electricity has been in connection with a method of treatment called *cataphoresis*.

Cataphoresis.—This is a term applied to the process of carrying medicinal agents in solution into the various tissues and organs of the body by means of the electric current. It is used chiefly for *obtunding sensitive dentin* and for the purpose of *anesthetizing the pulp* to facilitate its painless removal (see p. 285).

MASSAGE.

Massage is a term used to designate methodical kneading, rubbing, and percussion of the body. The person practising massage is known as a *masseur* (male) or *masseuse* (female). The efficacy of proper massage in many pathologic conditions can no longer be doubted. It acts as a stimulant to both nerve and muscle and to many of the bodily functions, assisting circulation and favoring the elimination of waste-products. Massage is employed in dentistry for both its local and systemic effects in *neuralgia*, *pyorrhea alveolaris*, *edemas resulting from alveolar abscess* and other conditions; in medicine it is used in *rheumatism*, *paralysis*, *synovitis*, *sprains*, and *fractures*. In the "rest cure" of Mitchell it is combined with isolation, rest, forced feeding, and faradism. It is also used for its general effect in *neurasthenia*, *nervous prostration*, and *hysteria*.

SUCTION.

The method of producing hyperemia in a part by means of **suction** for the purpose of combating disease is fast gaining recognition in medicine, and it has been employed also, to some extent, in dentistry.

When some noxious influence acts on a more or less limited area of the body, local resistance is manifested by the production of granulation tissue and of hyperemia. Under favorable circumstances the granulation tissue repairs defects resulting from the noxa, or more or less completely encapsulates the irritating agent. Under less favorable circumstances, the irritation being continuous, *e. g.*, in tuberculous infection, granulomata are formed, these granulomata being evidence of defense. If the resisting power is sufficient, the embryonic tissue overcomes the irritant and incloses it in fully developed scar tissue. Stimulation of the production of granulation in and around a tuberculous focus seems to be the therapeutic action of injections of emulsions containing iodoform, bismuth, finely divided carbon, etc., and of sclerogenic injections.

The second method by which nature resists a noxa (or infection) is by hyperemia. When an irritant, *e.g.*, the staphylococcus, gains access to the tissues, the flow of blood to the part becomes increased, there is exudation of fluids and leucocytes from the vessels into the tissues. The blood serum contains *antibodies* or *antitoxins* which neutralize the chemic products of bacterial activity; bacterial agents which attack the bacteria themselves; opsonins which prepare the bacteria for absorption and destruction by phagocytes, or perhaps act as a sort of appetizer to the phagocytes, and lastly there are the leucocytes

which act as phagocytes, directly killing bacteria or, as scavengers, removing the débris of the fight. Thus, while the granulation tissue acts as a sort of passive rôle besieging the invading irritant, the hyperemia directly and actively combats it (Binnie).[1]

The suction method of producing hyperemia cannot but prove efficacious in the treatment of certain forms of *alveolar abscess* and *pyorrhea alveolaris.* It now remains for some ingenious dentist to devise a practical appliance by which dental applications can be made, and much good will surely result from this method of assisting nature in her efforts to restore an abnormal to a normal condition. Keefe has applied suction in the treatment of *pyorrhea alveolaris* with good results by taking an impression in wax, removing and cutting the wax from around the imprints of the teeth, thus creating a space from which the air can be withdrawn, after reinserting the impression, by means of a large bulb or syringe attached to a tube leading through the impression tray and into the space.

The former application of the *leech,* called *leeching,* was something on this same principle, but the practice, especially in dental therapeutics, is gradually growing obsolete.

SUGGESTION.

Suggestion, as used in therapeutics, is the method of employing *faith* or *confidence* in the treatment of disease. There is no doubt but what faith is one of the oldest therapeutic agents known. Guerini[2] refers to the confidence placed in the power of the ancient priests to cure the sick, and how to maintain this confidence the latter gradually worked into the administration of infusions and decoctions made from fresh herbs, etc. With all peoples, from the earliest centuries to the present day, suggestion has ever been active. Where the disease is purely functional, and not organic, the influence which the mind can be made to exert over the body is a potent factor in the treatment of the condition, whether it be called *psychotherapy, mental-healing, Christian Science,* or by some other name.

Hypnotism is practised by many dentists as a means of preventing pain and controlling patients. Confidence is an important factor in dental practice. The dentist should ever strive to gain the confidence of his patients, be they young or old, and when obtained he should constantly guard against abusing it by careless and indifferent methods of operating.

[1] Journal of the American Medical Association.
[2] History of Dentistry.

METROLOGY.

Metrology is the science that treats of the gravitating force of a body called *weight;* its extension, bulk, or volume, called *measure,* and the relation of these to each other called *specific gravity.*

In pharmacy, liquids, as a rule, are measured, while solids are weighed; however, certain liquids are required to be weighed. The difference between measuring and weighing some liquids is not great, while with others it is considerable, and if this difference is not considered, varying results frequently follow. This, of course, is due to the different specific gravity of the liquids (*e.g.*, chloroform is heavy while alcohol is light).

The systems of weight in the United States are Avoirdupois and Apothecaries', or Troy.

The United States Pharmacopeia, in all of its editions previous to 1880, adopted the Apothecaries' weight as the official standard. In 1880 the *parts-by-weight system* was adopted. During the ten years of its official life this system never became popular, owing to the difficulty of having to weigh all liquids, regardless of their specific gravity. However, its adoption at this time paved the way for the adoption of the *Metric System* in 1890, and again in the eighth decennial revision of the U. S. P., in 1900. The metric system, therefore, is now the official standard. Nevertheless, although not officially sanctioned, the apothecaries' weight still remains in common use in prescribing medicines, owing to the ease with which it can be subdivided into simple fractions. Throughout this work the apothecaries' weight has been given the preference, the metric equivalent being enclosed in parenthesis. One troy ounce, equal to 480 grains, is easily divided by any even number—2, 4, 8, etc. This quality is of great practical value to the dispenser and prescriber alike. For the latter it simplifies prescription-writing because of its easy division; the quantity of a remedy required for administration may be computed with the measure of the solvent very quickly in simple fractions.

The fluid measure used in pharmacy can always be reduced to

drams—the equivalent of a teaspoonful. This being the measure ordinarily used in administering medicines, the quantity of a dose is readily ascertained. When, for example, 30 grains of potassium iodid in one fluidounce of compound syrup of sarsaparilla is prescribed, with directions "one teaspoonful at a dose," it is readily computed that the quantity of potassium iodid in each dose must be 3 3/4 gr., since one fluidounce contains eight fluidrams, or teaspoonfuls. The tables for the various systems of weight and measure are here given:

Troy, or Apothecaries' Weight.

20 grains (gr.)	= 1 scruple	(℈) =	20 grains.
3 scruples	= 1 dram	(ʒ) =	60 grains.
8 drams	= 1 ounce	(℥) =	480 grains.
12 ounces	= 1 pound	(℔.) =	5760 grains.

Wine, or Apothecaries' Measure.

60 minims (♏)	= 1 fluidram	(f ʒ).
8 fluidrams	= 1 fluidounce	(f ℥).
16 fluidounces	= 1 pint	(O).
2 pints	= 1 quart	(qt.).
4 quarts	= 1 gallon (Cong., C.) = 231 cubic inches.	

A fluidounce of water at its maximum density (4° C.) weighs 456.37 grains.

Avoirdupois Weight.

1 ounce (av. oz.)	= 437.5	grains.
16 ounces	= 1	av. ℔.
1 pound	= 7,000	grains.

The odd number of grains in the avoirdupois ounce, as compared with the round, easily divided number of grains of the apothecaries' ounce, is due to the fact that in the latter system the *unit* is the ounce, and from this the pound was formed. In the former the pound is the *unit*, which divided by 16 gives an ounce containing only 437.5 grains, as against 480 grains in the apothecaries' ounce.

The troy or apothecaries' weight is used in the compounding of prescriptions; the wine or apothecaries' measure is used for measuring liquids in pharmaceutic work, and the avoirdupois weight is in common use generally. The troy and avoirdupois *pounds* are abbreviated in the same manner, ℔., but differ in the number of grains contained (5,760, 7,000). The Troy pound is rarely used, and the

use of the scruple (℈) is practically obsolete; it is just as convenient to write for 20 grains, and there is less likelihood of a mistake, for the abbreviation for scruple may be taken for a carelessly written dram mark.

Approximate Fluid Measures

Teaspoonful	=fʒj
Dessertspoonful	=fʒij
Tablespoonful	=fʒiv
Wineglassful	=f℥ij
Teacupful	=f℥iv

One cubic inch of distilled water, at its maximum density, a temperature of 4° C. *in vacuo*, weighs 252.892 gr., and 231 cubic inches is a measure equivalent to the U. S. gallon. The *gallon* is divided into 8 pints; 1 *pint* into 16 fluidounces; 1 *fluidounce* into 8 fluidrams, and 1 *fluidram* into 60 *minims*. The measure of volume may, therefore, always be compared with the weight of water as above, the standard for comparison, thus:

One cubic inch = 252.892; 252.892 × 231 = 58,418 gr. = 1 gallon.
58,418 ÷ 8 = 7,302 grains = 1 pint.
7,302 ÷ 16 = 456.37 grains = 1 fluidounce.
456.37 ÷ 480 = 0.95 grains = 1 minim.

For all practical purposes a minim may be considered the equivalent of a grain (1 min. = 0.95 gr.). A *drop* is not a minim, although generally considered its equivalent, and the measurement of liquids by drops does not give uniform and accurate results. The size of drops varies greatly with different liquids; also with the same liquids, according to the conditions governing the process of dropping. Among these conditions may be mentioned:

1. The quantity of the liquid contained in the vessel.
2. The size and shape of the lip of the vessel.
3. The rapidity of the dropping.
4. The temperature and character of the liquid.

THE METRIC SYSTEM.

The metric system of weights and measures was first introduced in France at the close of the eighteenth century; hence it is often called the French system. Owing to its decimal parts, it is frequently termed also the *decimal* system. This system has gradually displaced all the

various systems of weights and measures throughout the European continent, and is the only recognized system in all countries except Russia, Great Britain and her colonies, and the United States of America. For this reason the metric equivalent has been given for quantities throughout this work.

Hallberg states that because of its simplicity in construction, regularity and convenience in exact calculations, it has become the only system for scientific work, and is no doubt destined to soon displace the older systems in art and commerce throughout the civilized world. Through our system of decimal numbering—ones, tens, hundreds, thousands, etc.—the *monetary* systems of all civilized nations, except Great Britain, have also become decimal and brought with them the metric system.

The functions of money and weights and measures are so intimately related and interdependent that a decimal system in one practically demands a decimal system of the other. The decimal system of money was one of the privileges accorded the people of the United States by early adoption, but while adopting this great improvement over the old English pound, shilling, and pence, the old English weights and measures, based on the penny-system, were unfortunately retained.

Although the U. S. Government, in 1867, made the metric system obligatory in the three branches of its medical service—the Army, Navy, and Marine Hospital—and also legally permissible throughout the Union, all efforts to make it obligatory in the various States have so far failed. It is difficult to change a long-established custom, but it does seem that there is little excuse for not adopting the metric system generally in the United States with our decimal proportions of the *dollar*, the *dime*, and the *cent*, based upon exactly the same principle.

The metric system is based upon the *meter*, which is the standard *unit* of *linear measure*, being the ten-millionth part of one-fourth of the circumference of the earth (the quadrant). It is, therefore, the one forty-millionth part of the entire circumference of the earth taken around the poles, measured by the *meridian* and not by the *equator*.

One *meter* is equal to 39.37 inches.

The *liter* is the *unit* of *liquid measure*, and is the cube of one-tenth of the meter, or cubic decimeter, and one-thousandth part of it, or the cube of one-hundredth of the meter is *one cubic centimeter*.

The *unit* of *weight* is the *gramme* or *gram*, the weight of one cubic centimeter of pure water *in vacuo* at its maximum density, and is equivalent to 15.432 grains.

The *unit gram* (written with a period immediately following, thus, 1.) is divided or multiplied to express smaller or larger denominational quantities, respectively, by simply moving the decimal point to

the left or to the right. This illustrates the simplicity of the entire system.

To designate the quantities thus obtained, *Latin* prefixes are used to describe those less than one gram, and *Greek* those larger than one gram—the former being written with a small letter, the latter with a capital letter.

Metric Weights.

1 myriagram	(Mg.)	=	10,000	grams.
1 kilogram	(Kg.)	=	1,000	grams.
1 hectogram	(Hg.)	=	100	grams.
1 decagram	(Dg.)	=	10	grams.
1 gram	(Gm.)	=	weight of 1 c.c. of water at 4° C. (unit).	
1 decigram	(dg.)	=	0.1	gram.
1 centigram	(cg.)	=	0.01	gram.
1 milligram	(mg.)	=	0.001	gram.

Metric Measures of Capacity.

1 myrialiter	(Ml.)	=	10,000,000	cubic centimeters.
1 kiloliter	(Kl.)	=	1,000,000	cubic centimeters.
1 hectoliter	(Hl.)	=	100,000	cubic centimeters.
1 decaliter	(Dl.)	=	10,000	cubic centimeters.
1 liter	(L.)	=	1,000	cubic centimeters (unit).
1 deciliter	(dl.)	=	100	cubic centimeters.
1 centiliter	(cl.)	=	10	cubic centimeters.
1 milliliter	(ml.)	=	1	cubic centimeter.

Equivalents in the English Weights and Measures.—Various methods have been proposed for adapting the metric weights to our apothecaries' weights used in prescription-writing without entailing calculations in fractions, as the exact equivalent would necessarily do. The method of accepting 32 grams as equivalent to one troy ounce and 30 c.c. as equal to one fluidounce seems to be the least objectionable.

To convert avoirdupois or troy into metric weights, the equivalent of the gram in grains—15.432—should be remembered, as it serves the purpose of a basis for obtaining the equivalent of all the higher denominations. It will be observed that this number is composed of the first five numerals in reversed order, except the figure 1. For all practical purposes the fraction may be dropped, and 1 gm. may be said to equal 15 gr.

The *Liter* is equivalent to 34 fluidounces (approximately 1 quart); half a Liter, therefore, approximating 1 pt., and is sometimes called a *metric pint* (17 fl. oz.).

The *Meter* is equivalent to nearly 40 inches, from which the divi-

sions may easily be rendered as follows: 1 decimeter, 4 in.; 1 centimeter, cm., 0.4 in.; 1 millimeter, mm., 0.04 (1/25) inch.

Hallberg sums up the advantages of the metric system as follows:

1. Simplicity of construction, abolishing complex tables.

2. Uniformity, through its adoption in all scientific work.

3. Permanency and stability of its standard unit derived from the earth itself.

4. Facility of its multiplication and division by decimal points.

5. Commensurability of all its units and denominations in *weight*, *volume*, *linear* measures, and our system of *money*.

Equivalents of Apothecaries' in Metric Weights.

Grain.		*Gram.*	*Grain.*		*Gram.*
1/200	=	.000324	1/2	=	.0324
1/150	=	.00043	1	=	.0648
1/100	=	.00064	2	=	.1296
1/75	=	.00086	5	=	.3240
1/50	=	.00129	8	=	.5184
1/40	=	.00162	10	=	.6480
1/20	=	.00324	15	=	.9720 (approx. 1.0 gm.).
1/10	=	.00648	20	=	1.2960
1/6	=	.0108	30	=	1.9440 (approx. 2.0 gm.).
1/4	=	.0162	40	=	2.5920
1/3	=	.0216	60	=	3.888 (approx. 4.0 gm.).

Equivalents of Apothecaries' in Metric Measures of Capacity.

Minims.		*Cubic centimeters.*	*Fluidounces.*		*Cubic centimeters.*
1	=	0.061	1	=	29.57
2	=	0.123	2	=	59.14
3	=	0.185	3	=	89.00
5	=	0.308	4	=	118.29
7	=	0.431	6	=	177.42
10	=	0.616	10	=	295.73
15	=	0.924 (approx. 1.0 c.c.)	12	=	355.00
20	=	1.23	16	=	473.17 (approx. 1/2 L.)
30	=	1.84 (approx. 2.0 c.c.)	20	=	591.50
40	=	2.46	24	=	710.00
60	=	3.7 (approx. 4.0 c.c.)	32	=	946.35 (approx. 1 L.)

PERCENTAGE IN SOLUTIONS.

To estimate the quantity of a drug required to make a certain volume of a solution of a given percentage, *multiply* the weight of the volume of the liquid to be used as the solvent by the percentage. Thus, in an ounce of a 10 per cent. *aqueous* solution of silver nitrate there are 45.6 grains of the salt.

100% = 456.37 gr. (weight of a fl. oz. of water).
1% = 1/100 of 456.37, or 4.56 gr.
10% = 10 × 4.56, or 45.6 gr.

Therefore, it is well to remember that 4.56 gr. or, approximately, 4.5 gr. of any drug added to a fluidounce of water makes a 1 per cent. solution of the drug. The amount of a drug necessary for any quantity of any per cent. solution may be ascertained by *multiplying* the quantity by the percentage by 4.5. Thus, to ascertain the amount of cocain hydrochlorid required to make two ounces of a 1.5 per cent. solution, we would *multiply* $2 \times 1.5 \times 4.5 = 13.5$ gr. Where there is a fraction of a grain in the ultimate result it is best to drop it if less than one-half, or raise it to one if over one-half.

To determine the weight of a fluidounce of a liquid other than water, *multiply* 456.37 by the specific gravity of the liquid, and the product will be the weight desired.

PRESCRIPTION-WRITING.

The literal interpretation of the word *prescription* is *a written order for something*—from *præ*, for, and *scribo*, I write. The popular use of the term, however, relates to medicines, usually meaning a written order for medicines, although it is frequently employed to designate the remedy or mixture itself.

The art of prescription-writing is one that requires practice for its perfection, as well as a broad knowledge of drugs, their actions and their doses, and their indications for certain diseases. It is also essential to know the physical and chemic properties of drugs as related to form of administration and possible combination with other substances. Through the development of the sciences of pathology and pharmacology we have learned that it is unnecessary to exhaust our materia medica in prescribing for any one disease, and with this more definite knowledge of the action and effects of drugs upon the diseased tissues, organs, and functions of the body, we find that only a few agents can be employed with actual benefit in our endeavor to assist Nature in her efforts to restore an abnormal to a normal condition. To-day simplicity of prescriptions is evidence of a broad knowledge of the conditions to be met by the application of drugs or remedies to the treatment of disease. In former days many drugs were combined in one prescription, and the remedy given with the hope and expectancy that at least one ingredient might, perchance, hit the spot. To such formulas the term "shot-gun" prescriptions is now applied.

The most important considerations in *writing* prescriptions as well as in *reading* them are:

1. The language and abbreviations.
2. The signs and terms.

The *language* of prescription-writing is primarily Latin, because pharmacopeial titles are chiefly used in designating remedies. Medical Latin will be referred to later. *Abbreviations* in prescription-writing is perfectly proper, providing they are not carried so far as to cause confusion in compounding the prescription. The *signs* and *terms* used will be considered conjointly with the analysis of a prescription.

A prescription may be divided into five parts, as follows:

1. The superscription, or heading.
2. The inscription, or names and quantities of ingredients.
3. The subscription, or directions to the compounder.
4. The signa, or directions to the patient.
5. The name of the prescriber, his degree, and the date.

The *superscription*, or heading, consists of the abbreviation ℞, for the imperative of the verb recipio—*recipe*, with a terminal stroke on the R, forming the sign of Jupiter, ♃, which survives as a relic of ancient times when all medical formulæ were preceded by this sign as an invocation to Jupiter, the chief God. Literally translated "take thou" or "take," it tells the pharmacist to compound the ingredients which follow. The name of the patient is generally though not necessarily included in this part. A perfect prescription should always bear the name of the person for whom the medicine is intended, and if for a child it should be so designated.

The *inscription*, containing as it does the names and quantities of the ingredients, is the most important part of the prescription, and the ingredients are invaribly written in Latin with the *genitive* ending, the quantities following on each line, indicated by the customary abbreviation. Thus: gr. for granum, plural grana—grain or grains; ʒ for dram (drachma); ℥ for ounce (uncia); and O for pint (octarius). The abbreviations ℔ for pound (libra) and Cong. or C. for gallon (congius) are rarely employed. ♏ stands for minim (minimum); and the fluidrams and ounces are indicated by the prefex f, thus fʒj, f℥j. *Semissis*, abbreviated *ss*, is used to indicate a half. A prescription written with the troy system of weights always contains *Roman* numerals: gr. iv, gr. xx, etc.; when written with the metric weights and measures they are expressed in decimals in *Arabic* numerals, preceded by gm. or c.c., signifying weight or measure: gm. 5.65, c.c. 30.0.

Signs for designating the measure or weight of the mixture are sometimes affixed to the last ingredient. The most commonly used are:

Ad, the preposition "to"; ad f℥iij = to (measure) three fluidounces. *Quantum sufficiat*, abbreviated q. s.—as much as is sufficient. Of these signs q. s. is preferable, since *ad* may be confused with the abbreviation of the verb *adde*, meaning to add. *Ana*, abbreviated *āā*, meaning of each, is appended when the same quantities are required of two or more ingredients; it follows the last of these, just preceding the quantity.

While it is the rule that every word in the inscription must terminate in the genitive or accusative (the names of the ingredients in the genitive, the quantities in the accusative), they are rarely written out in full, but nearly always abbreviated. Where the first, or the first and second, syllables of words are the same, *e. g.*, hydrargyrum and hydrastis, the abbreviation must not be carried so far as to involve doubt as to which drug is really meant. To further illustrate, the drugs just mentioned are often abbreviated hydr., which may mean either of them, or when followed with chlor., would doubtless mean hydrated chloral, but might also be mistaken for hydrargyrum chloridum; both calomel and mercuric chlorid being sometimes erroneously, though not infrequently, so written. The author's experience behind the prescription-counter leads him to emphasize the importance of correctly writing the inscription.

The complete inscription is made up of the *basis*, or active constituent; the *adjuvant*, or aid to the basis; the *corrective*, or agent to counteract, modify, or correct some unpleasant property of the basis; and *forming substance*. The forming substance is variously termed according to the form or consistence of the mixture. For liquids and ointments it is called *vehicle;* for powders, *diluent;* and when in a mass, as in pills or troches, *excipient*. This is according to the maxim of Asklepiades, which reads *curare* (basis), *cito* (adjuvant), *tuto* (corrective) *et jucunde* (vehicle, diluent, or excipient), to cure quickly, safely, and pleasantly. Most prescriptions do not contain all of these ingredients; many call for but one.

The *subscription* consists of certain signs and terms conveying directions as to the compounding and dispensing. Generally it is better to leave the detail of compounding to the pharmacist who is trained in the art of pharmacy; therefore, the abbreviation, M, which stands for the Latin imperative of the verb *misce*, meaning mix, is usually all that is necessary. This sign may follow a dash, thus —M., just to the right of the last ingredient in the inscription, or it may be placed to the left under the sign of the superscription. When special directions are necessary, as in directing the number of powder, capsules, or pills, into which the mixture is to be divided, they may be written in either Latin or English—the former is preferable, providing they are correctly written.

Special directions abbreviated are:

M. ft. pulv. chart, div. (No.—), mix and make a powder, divide in papers (No.—). M. ft. cap. (No.—), mix and make capsules (No.—). M. ft. mass. pil. div. (No.—), mix and make a mass, divide in pills (No.—).

The *Signa*, abbreviated Sig. or S., includes the directions to be written on the label and affixed to the package or container. These should be written in English in a plain, bold hand-writing. Sometimes it is better for the patient not to know what drug is taken, for this reason the inscription and subscription are written in Latin, but no secrecy is necessary here; in fact, to write the directions in plain English and to read them to the patient or attendant may serve as a check on any possible error in copying the directions on the label. The stereotyped expression, "Use as directed," should be avoided as far as possible, especially where the prescription is intended for internal administration. Many serious consequences might have been averted if specific directions were given.

The *name* of the subscriber, his *degree*, and the *date* are added below the signa. Generally it is not in good taste to flourish the degree after one's signature every time it is written; but in the case of a prescription it is essential for authenticity. The pharmacist desires to know whether the prescriber has the right to prescribe, and this can only be known by the degree. When prescription blanks are used, having the prescriber's name, degree, and address printed above or below the space reserved for the prescription proper, all that is necessary is to write the initals and the date. The date is valuable for reference.

It may be questioned by some whether dentists have the right to prescribe internal remedies. A large part of the work of the dentist is to treat the diseases of the mouth and adjacent tissues, thus alleviating human suffering, and surely he has the right to use any drug which he knows from his experience will aid Nature in overcoming the pathologic condition. The author entered upon the practice of dentistry through the gateway of pharmacy, and it has been his experience, both as a pharmacist and as a dentist, that the right to prescribe will never be questioned if intelligence is shown in the writing of the prescription.

The *order* usually adopted in prescription-writing is as follows: First, after the ℞, the names of the ingredients are written, in the order of their importance; then the number of doses is decided upon, the individual dose of each drug *multiplied* by the number of doses gives the quantities to be affixed to the names of the ingredients. In selecting the proper quantity for liquid mixtures, the regular sizes of vials alone are considered. These are 1, 2, and 4 dram, and 1, 2, 3, 4, 6, 8, and 16 ounce capacity, and it should be remembered that in all cases a bottle should be filled. A partially filled bottle immediately arouses suspicion on the part of the patient as to the possibility of mistake in compounding the prescription.

MEDICAL LATIN.

The language used in prescription-writing is primarily Latin, because pharmacopeial titles are chiefly employed in designating remedies. It is never necessary to tell the patient what drug is being used, and frequently it is far better that they do not know, because of certain idiosyncrasies, prejudices, and other reasons. Therefore, it is better to always write the inscription and sometimes the subscription of a prescription in Latin. The rule is to have the name of every ingredient end in the genitive and the quantities in the accusative. It is true that much ignorance of the Latin language can be covered up in prescription-writing by using abbreviations, and while it is also true that to abbreviate is perfectly proper, providing it is not carried so far as to involve doubt as to what drug is wanted; nevertheless, a working knowledge at least of this dead language will be of inestimable value. Therefore, a few rules of *Latin grammar*, applicable to prescription-writing are here given: The quantities of the ingredients appear in the *accusative* case, governed by the imperative of the verb "Recipe"; the quantities, however, are seldom written out in full. The *names* of the ingredients appear in the *genitive* case, the construction reading "Recipe drachmam unam phenolis," take one dram of phenol, ℞ phenolis, ʒj. The directions to the pharmacist are very simple, unless special directions are necessary: M. for "misce," is generally all that is required. The directions to the patient should always be written in English. All nouns ending in *a* in the nominative, end in *æ* in the genitive, and are of the first declension; the accusative ends in *am* and the nominative plural in *æ;* there are a few exceptions of Greek derivation, such as enema, gramma, theobroma, —the genitive ending for these is *atis*. Nouns terminating in *us* in the nominative, end in *i* in the genitive, and are of the second declension, *um* for the accusative singular, and *i* for the nominative plural; there are a few exceptions to this rule with nouns of the fourth declension, as fructus and spiritus (these do not change in the genitive). The nouns ending in *um* in the nominative singular are neuter in gender and of the second declension; they change to *i* in the genitive, *um* in the accusative, and *a* in the nominative plural. All other pharmacopeial nouns belong to the third declension and change variously in

the different cases, and for the most part must be studied individually. For example: *as* becomes *atis; is* may remain *is* or change to *idis, itis,* or *eris* in the genitive; the accusative of *as* becomes *am,* the nominative plural *atea.* Some nouns do not change at all, *e.g.*, sassafras. Adjectives agree with their nouns in number, gender, and case; those ending in *us,* terminate with *a* for the feminine and *um* in the neuter gender, and are declined according to the first and second declensions. Adjectives ending in *is* and *ens* are declined according to the third declension; the first ends in *e* in the neuter gender. A few nouns of Greek origin end in *ë,* and form a genitive of *ës,* and an accusative of *ën;* aloe, aloës, is an example.

When special directions are necessary for the dispensing of *powders, capsules,* and *pills,* they may be given as follows: *Fiat pulvis et divide in chartulas No.* x.—make a powder and divide into 10 papers. *Dispensa in capsulis No. xij*—dispense in 12 capsules. *Fiant pilulæ No.* xx—make 20 pills.

An *official formula* may be specified in a prescription as follows: ℞ Pulveris opii et ipecacuanhæ, gr. xx. Fiat chartulas No. iv. Sig. —Take one or two powders on retiring and keep well covered. In this prescription the nominative pulv*is* changes to pulv*eris* in the genitive; opi*um* changes to opi*i;* and ipecacuanh*a* changes to ipecacuanh*æ.* Thus the value of the above rules of Latin grammar is seen. To abbreviate the names of the ingredients in the above, we could use pulv. for pulveris, ipecac. for ipecacuanhæ, but we could not intelligently abbreviate opii—it would be necessary to write in full in the Latin nominative or the English (which is the same in this instance—opium). To write it in the Latin nominative in the inscription is wrong, and to write it in English with the other words abbreviated in Latin is also wrong. So while much ignorance of the Latin language may be covered up by abbreviation in prescription-writing, occasionally this lack of knowledge will manifest itself; therefore it is the wiser plan to become familiar with these simple rules. As has been elsewhere stated, the art of prescription-writing is one that requires a great deal of practice for its perfection.

In conclusion the author desires to state that if any part of the inscription or subscription cannot be properly written in Latin, by all means write the entire prescription in English. This is by no means meant to discourage the use of Latin in prescription-writing.[1]

[1]Those desiring to study this subject further will find St. Clair's "Medical Latin" a valuable book.

EXAMPLES OF PRACTICAL PRESCRIPTIONS.

Powders.

For Mrs.————.

℞—Pulveris Acetanilidi Compositæ, gr. xv (1.0 gm.).
Fiat chartulas No. ij.

Sig.—Take one (1) powder at once and the other in two (2) hours, if not relieved.

(Date) ————, D. D. S.

For Baby ————.

℞—Hydrargyri chloridi mitis,		gr. j (0.06 gm.)
Sodii bicarbonatis,		gr. xx (1.3 gm.)—M.
Fiat chartulas No. x.		

Sig.—Take one (1) powder every hour until three (3) or four (4) are taken.

(Date) ————, D. D. S.

For Mr. ————.

℞—Acetphenetidini,		
Salophen,	āā	gr. x (0.6 gm.)
Codeinæ Sulphatis,		gr. j (0.06 gm.)—M.
Fiat chartulas No. iv.		

Sig.—Take one (1) powder every three (3) hours.

(Date) ————, D. D. S.

Tooth Powders.

No. 1.

For General Use.

℞—Calcii carbonatis ppt.,		℥xiv (448.0 gm.)
Saponis pulveris (U. S. P.),		
Sacchari pulveris,	āā	℥ij (64.0 gm.)
Sodii benzoatis,		℥ss (16.0 gm.)
Eucalyptolis,		♏x (0.6 c.c.)
Thymolis,		gr. x (0.6 gm.)
Cinnaldehydi,		♏xv (1.0 c.c.)—M.
Fiat pulvis.		

Sig.—Use as a general tooth-powder.

(Date) ————, D. D. S.

No. 2.

For General Use.

℞—Calcii carbonatis ppt.,		℥xx (640.0 gm.)
Orris radices pulv.,		℥iv (128.0 gm.)
Saponis pulv. (U. S. P.),		℥ij (64.0 gm.)
Sacchari,		
Sodii boratis,	āā	℥j (32.0 gm.)
Thymolis,		gr. xv (1.0 gm.)

Eucalyptolis, ♏x (0.6 c.c.)
Olei gaultheriæ,
Olei menthæ piperitæ, āā ♏xx (1.3 c.c.)—M.
Fiat Pulvis.
Sig.—Use as a general tooth-powder.
(Date) ———, D. D. S

Capsules.

For Mr. ———.

℞—Quininæ bisulphatis, gr. xxiv (1.5 gm.)
Dispensa in capsulis No. viij.
Sig.—Take one (1) capsule before meals and on retiring.
(Date) ———, D. D. S.

Pills.

For Mrs. ———.

℞—Quininæ valerianatis, gr. xviij (1.2 gm.)
Extracti hyoscyami, gr. iv (0.26 gm.)
Extracti cinchonæ, gr. viij (0.5 gm.)—M.
Fiat massa et divide in pilulæ No. xij.
Sig.—Take one (1) pill before meals and on retiring.
(Date) ———, D. D. S.
(*Cosmos.*)

Solutions (Dobell's Solution).

For Mr. ———.

℞—Sodii bicarbonatis,
Sodii boratis, āā ʒj (4.0 gm.)
Phenolis (crys.), ʒss (2.0 gm.)
Glycerini, f℥j (30.0 c.c.)
Aquæ, Oij (1.0 L.)—M.
Sig.—Use as a spray, mouth-wash, or gargle.
(Date) ———, D. D. S.

(Antiseptic Solution U. S. P.)

For Mrs. ———.

℞—Liquoris Antiseptici, f℥viij (240.0 c.c.)
Sig.—Dilute with one-half warm water and use as a mouth-wash.
(Date) ———, D. D. S.

For Miss ———.

℞—Antipyrini, ʒss (2.0 gm.)
Sodii bromidi, ʒj (4.0 gm.)
Glycerini, fʒij (8.0 c.c.)
Aquæ cinnamomi, q. s. ad. f℥j (30.0 c.c.)—M.
Sig.—Take a teaspoonful three times a day, after meals.
(Date) ———, D. D. S.

For Mrs. ———.

℞—Potassii iodidi, ʒjss (6.0 gm.)
Syrupi sarsaparillæ comp., f℥iij (90.0 c.c.)—M.

Sig.—Take a teaspoonful in water three times a day, after meals.
(Date) ———, D. D. S.

For Mr. ———.

℞—Acetanilidi, gr. viij (0.5 gm.)
Syrupi simplex, f℥ss (15.0 c.c.)
Spiritus frumenti, q. s. ad. f℥iij (90.0 c.c.)—M.

Sig.—Take one-half at once and the remainder in two (2) hours, if not rèlieved.
(Date) ———, D. D. S.

Collyrium (Eye-water).

For Mr. ———.

℞—Sodii boratis, gr. x (0.6 gm.)
Acidi borici, sat. sol., f℥j (30.0 c.c.)—M.

Sig.—Warm to body temperature and drop into the eye with a drop applicator.
(Date) ———, D. D. S.

Gargle (Mercurial Stomatitis or Sore Throat).

For Miss ———.

℞—Potassii chloratis, ʒjss (6.0 gm.)
Tincturæ myrrhæ, fʒij (8.0 c.c.)
Alcoholis, f℥ss (15.0 c.c.)
Aquæ cinnamomi, f℥vi (180.0 c.c.)—M.

Sig.—Thoroughly gargle the throat three times daily. If too strong, dilute with warm water.
(Date) ———, D. D. S.

Liniments.

For Dentists' Use.

℞—Mentholis,
Iodi (crys.), āā gr. x (0.6 gm.)
Chloroformi, fʒjss (6.0 c.c.)
Tincturæ Aconiti, q. s. ad. f℥j (30.0 c.c.)—M.

Sig.—Use as a refrigerant counterirritant.
(Date) ———, D. D. S.

For Dentists' Use.

℞—Mentholis, gr. xx (1.3 gm.)
Chloroformi, fʒjss (6.0 c.c.)
Tincturæ aconiti, q. s. ad. f℥j (30.0 c.c.)—M.

Sig.—Apply freely to gums in cases of nonseptic pericementitis.
(Date) ———, D. D. S.

For Mr. ———.

℞—Camphoræ (gum),		ʒij (8.0 gm.)
Tincturæ aconiti,		f℥j (30.0 c.c.)
Linimenti saponis,	q. s. ad.	f℥iij (90.0 c.c.)—M.

Sig.—Apply locally with massage in cases of neuralgia.

(Date) ———, D. D. S.

INCOMPATIBILITY IN PRESCRIPTIONS.

When two or more different substances are brought together in a mixture, be it liquid or solid, with the result of undergoing a more or less complete change, not intended, they are said to be *incompatible.*

Incompatibility, so far as it applies to the combination (not the action) of drugs, may be of two kinds—*physical* and *chemic.* The only truly scientific method of determining the incompatibility, or the contrary, of the ingredients of a mixture is a correct knowledge of physical and chemic laws and their practical application in pharmacy and therapeutics.

Physical incompatibility is largely a question of the solubility of drugs. It results when precipitates are formed without the precipitated substance losing its former identity; *i. e.*, without chemic change. It also occurs when an effort is made to mix nonmiscible substances, as oil and water.

Gums and other mucilaginous substances are soluble in water, but insoluble in alcohol. Therefore, the addition of alcohol to an aqueous solution of a gum results in the precipitation of the gum without chemic change.

Example: Mucilage of tragacanth with any alcoholic tincture (tincture of aconite) will precipitate the tragacanth.

Resinous substances are soluble in alcohol, but insoluble in water. The addition of water, therefore, to an alcoholic solution of a resin results in the physical precipitation of the resin.

Example: Water added to tincture of podophyllum will precipitate the resinous active constituent, *podophyllin.*

Any mouth-wash or solution containing a considerable amount of the essential oils, held in solution by alcohol, will become turbid upon the addition of water, due to the physical incompatibility of the oil and water.

Chemic incompatibility involves a chemic change when substances are mixed, whereby their former identity is lost. To be able to predict chemic incompatibility requires a knowledge of chemic laws and their practical application. It is well to remember a few of the more common of these laws. For example:

1. It is a principle in chemistry that when solutions of soluble salts are brought together there is generally an exchange of radicals

with the formation of a precipitate, if either of the newly formed salts is insoluble. To illustrate: When solutions of silver nitrate and sodium chlorid are brought together a white precipitate of silver chlorid is formed. Here there is an exchange of radicals, and the silver chlorid, being insoluble in the water, is precipitated, while the sodium nitrate, being soluble, dissolves as soon as it is formed. Advantage is taken of chemic incompatibility when silver nitrate is used about the mouth; any excess can be neutralized at once by having the patient rinse the mouth with a solution of common salt.

2. Strong mineral acids decompose salts of the weaker mineral or vegetable acids, and also form ethers with alcoholic preparations. To illustrate: Sodium bicarbonate is chemically incompatible with hydrochloric acid. Here the chlorin of the hydrochloric acid has a greater affinity for sodium than has the weaker carbonic radical, hence it displaces the latter, forming sodium chlorid and liberating carbonic acid, which immediately breaks up into water and carbon dioxid. The carbon dioxid being a gas causes the effervescence. An illustration of the formation of ethers by adding a strong mineral acid to alcoholic solutions is found in making ether, where sulphuric acid is added to alcohol. In this case, of course, sulphuric acid and alcohol are not considered incompatible because ether is the product desired, but if it were not, then they would be chemically incompatible.

As a matter of fact, all *drugs* are incompatible with their *chemic tests* or *antidotes*, a knowledge of which means a knowledge of the science of chemistry, and to mention all would be inappropriate in a work of this kind. A few common examples are here given:

Alkalies and *alkaline carbonates* are incompatible with *acid solutions, acid salts*, and *alkaloidal salts*. *Arsenic trioxid* with *tannic acid* and *salts of iron*. *Alkaloids* and *alkaloidal salts* with *tannic acid*. *Phenol* with *collodion*. *Powerful oxidizing agents* with *easily oxidizable substances*, causing combustion, and even explosion. Oxidizing agents are: potassium chlorate, potassium permanganate, chromic, nitric, and nitrohydrochloric acids. Easily oxidizable agents are: sugar, glycerin, alcohol, fats, sulphur, carbon, and phosphorus.

The following drugs, so far as possible, had better be prescribed alone:

Strong mineral acids.	Potassium Chlorate.
Alkalies.	Potassium Permanganate.
Arsenic Trioxid.	Silver Nitrate.
Iron salts.	Tannic Acid.

Mercuric Chlorid (incompatible with almost everything).

ANTAGONISM OF DRUGS.

As has been observed in the study of physiologic action, certain drugs produce opposite effects. This is known as *antagonism of drugs*, called also *physiologic* or *therapeutic incompatibility*. The antagonistic effects of drugs is recognized in therapeutics as a means of guarding against *drug poisoning* or in the *treatment of poisoning* when toxic symptoms are manifested. In this connection the term *physiologic antidote* is used.

The antagonistic action of drugs, however, is never as positive as is the case with chemic incompatibility, for there are few drugs, indeed, whose action is directly opposite, and whose effects will neutralize completely the effects of other drugs. The antagonism of drugs or physiologic antidotes is well illustrated in the *treatment of cocain poisoning* (see p. 123).

PART II.

PRACTICAL DENTAL THERAPEUTICS.

GENERAL CONSIDERATIONS.

Therapeutics is the application of drugs or remedies to the treatment of disease. Dental therapeutics differs in no way from general therapeutics, except it includes only the treatment of diseases of the mouth and adjacent structures or such general diseases as are manifested in the mouth. In the latter instance it is the duty of the dentist to collaborate with the family physician in the treatment of the case.

In considering the practical therapeutics of the more common diseases which the dentist is called upon to treat, the author will draw largely upon his own experience gained from actual practice and from extensive reading of current dental and medical literature.

It should be understood at the outset that there are three essential factors upon which all successful therapeutics rests. *First,* to be able to recognize a pathologic condition and make a correct diagnosis. This means that the successful therapeutists must possess a broad knowledge of general pathology and a special knowledge of dental or oral pathology; *secondly,* to know what drug, or remedy, if properly applied or administered, will reach the recognized pathologic condition and act the most favorably. This means that successful therapy depends upon a broad knowledge of pharmacology—a science which treats of the action of drugs and remedies upon the tissues, organs, and functions of the body; and *thirdly,* to have at hand, in a convenient and practical form, that drug or remedy which experience has taught will assist Nature in her efforts to restore an abnormal to a normal condition.

The tendency in dental as well as in general therapeutics to-day is to place the treatment of disease upon a rational basis. The progressive dentist, therefore, is no longer satisfied to know that results may be obtained by the use of certain remedies in the treatment of certain diseases, but he has a strong desire to know also *why* those results are brought about. In the following pages only such pathologic data will be given as is deemed essential incident to the therapeutics of the condition under consideration, but every effort will be made to tell,

as far as is known, why the remedies suggested are indicated and what may be expected from their judicious employment. This means that it will be necessary to practically discard all obsolete or untried remedies. In other words, only such remedies will be considered in detail here as have been found to be of real practical value.

DISEASES OF THE HARD TISSUES OF THE MOUTH AND ASSOCIATED STRUCTURES.

HYPERSENSITIVE DENTIN.

GENERAL CONSIDERATIONS.

Authorities differ in regard to the sensitivity of dentin. According to Barrett, dentin in the normal condition should be without sensation; the source of sensitive dentin, or of impressionable pulps, lies in their continued subjection to irritation by which responsiveness is developed. Burchard-Inglis states that all vital dentin is sensitive; that the degree of sensitivity differs markedly in individuals; and it is only when hypersensitiveness is observed that the condition becomes pathologic. It might also be mentioned that the sensitivity differs in the same individual at different times. Black differentiates between hypersensitiveness and thermal sensitiveness of dentin, claiming that the sharp pain caused by sudden changes of temperature is normal, though no other tissue or organ of the body shows a like resistance to thermal changes. Under certain conditions hypersensitiveness to thermal changes may develop, when the condition becomes pathologic. Thermal sensitiveness as well as hypersensitiveness of dentin is often developed during the progress of decay, therefore, in the preparation of cavities for fillings we find few teeth the dentin of which is without sensation. This fact is not surprising, nor can it be construed as being contrary to the statement that normal dentin is not sensitive when we remember that there are few teeth in the mouths of patients demanding the services of the dentist, the dentinal fibillæ and pulps of which have not been subjected to continued irritation.

In the discussion of means and methods by which the sensitiveness of the dentin can be allayed, I shall not attempt to enter into the details of the many histologic and pathologic phenomena which are certain to arise in the consideration of the *therapeutics* of this subject, but shall confine myself largely to the drug aspect.

The sensitiveness of the dentin can be obtunded in no small degree by the use of various therapeutic agents; and I might state that there are few operations which we are called upon to perform wherein the patient will appreciate our efforts more than in this by applying drugs

and remedies for the mitigation of pain. But in order to apply intelligently and successfully any remedy, whether it be a drug or an agent, to the dentin and thereby obtund the sensitivity of the dentinal fibrillæ without endangering the vitality of the pulp itself, we must be familiar with several factors or conditions, which I cannot with propriety here discuss, in detail at least. For instance, a thorough knowledge of the anatomic and histologic structure of the tooth is of the highest importance, as is also a knowledge of the pathology, not only of the fibrillæ, but of the pulp tissue as well—the changes which these structures are capable of undergoing if unduly irritated by the application of the remedy employed. Still another factor of equal importance, and one which more directly relates to the phase of the subject under consideration, is a knowledge of the pharmacologic action and the therapeutic application of the drugs and remedies used for this purpose. Before using a drug or an agent for allaying the sensitiveness of dentin, or for any other purpose, we should know what *action* to anticipate from its employment. This is not too much to expect from the trained dental practitioner of to-day.

THERAPEUTICS.

The remedies suggested for obtunding sensitive dentin have been many and varied. I shall discuss only those which, from clinical experience, have proved of sufficient value to merit consideration; and for convenience of study, will divide them into four general classes.

I. PHYSICAL AGENTS.

There are some physical agents by the proper use of which the sensitiveness of dentin can, in a measure, be obtunded. The most common are:

Heat.	Light.
Cold.	Electricity.

Heat.—The application of dry heat to a sensitive cavity, especially in conjunction with a dehydrating agent, such as absolute alcohol, is always an aid; and this is accomplished by means of heating dry air, and gently directing a current of air thus heated into the cavity which has been insolated by the rubber dam and moistened with the dehydrating agent used. Care must be taken not to primarily cause pain, otherwise the object of using the agent would be defeated.

Several apparatuses have been devised for heating the air. Dr. Rudolph Beck has recently perfected a convenient electrical device by means of which compressed air can be heated as it passes through. Other such devices are on the market. In the absence of any of these, the chip-blower can be employed, however, with less satisfaction. Inasmuch as heat is used in conjunction with another and more important class of remedies, I shall refer to this agent later.

Cold.—This is another physical agent sometimes employed for the purpose of desensitizing the dentin. Heat may be abstracted from the tooth-structure by spraying the cavity with a highly volatile liquid, like ether, rhigolene, or ethyl chlorid. In the use of these agents, advantage is taken of the physical law that *a solid in changing its form to a liquid, or a liquid in changing its form to a vapor or gas, must abstract from the thing to which it is applied, a certain amount of heat in order to effect the change.* Ether, or combinations containing ether, and ethyl chlorid, both used as sprays, have proved valuable in some instances, especially shallow cavities near the gum the dentin of which is difficult to obtund by the usual methods employed, and to which reference will be made later.

A precaution to be taken to prevent primary pain in applying this remedy is to fill the cavity temporarily with stopping and direct the spray first on this and surrounding parts, after which the stopping can be removed and the spray directed into cavity without any appreciable pain. The degree of refrigeration must not be carried to the point of having a possible deleterious effect subsequently upon the pulp or gum tissue.

A practical method of combining dryness and cold as a means of obtunding sensitive dentin has been suggested by Dr. W. T. Reeves. It consists in directing a small jet of compressed air directly into the cavity a few moments before operating, and keeping it up during the drilling process. To prevent primary pain, cotton saturated with an analgesic and antiseptic remedy may be placed in the cavity first. The air serves a threefold purpose; it keeps the cavity dry; clears the field from chips; and, what is important here, it lessens the heat of drilling which is responsible for most of the pain in cavity preparation. Those inexperienced with the method must be careful at first, as the absence of pain and the clear field may lead one to think that the bur is not cutting, as a result one is liable to drill deeper than is absolutely necessary.

Light.—This agent has recently been brought forth as having a peculiarly favorable effect upon hypersensitive patients. In one method

the rays of light are colored by passing through a blue glass. This is accomplished by darkening the room and employing a blue bulb (16 or 32 c. p.) on an ordinary electric socket. Whether the light acts locally or affects the vision and thus the general nervous system, has yet to be demonstrated. The result of the author's experience with this agent thus far has not been encouraging.

Electricity.—The electric current has been employed as a means of carrying certain drugs into the dentin and pulp tissue for obtundent purposes. The method is called *cataphoresis;* but because of the expensive and complicated apparatus, the length of time required to obtund as well as oftentimes unsatisfactory, and, in not a few instances, disastrous results, the method has generally been discarded.

II. ESCHAROTICS OR CAUSTICS.

Any drug or agent which will cauterize the dentinal fibrillæ, will obtund sensitive dentin. There are many drugs, however, belonging to this class that cannot be used for this purpose because of their deleterious effect upon both the tooth structure and the pulp tissue. For instance, the strong mineral acids will disorganize the protoplasmic dentinal fibrillæ; but they will also disintegrate the inorganic structure of the tooth. Arsenic trioxid has a specific poisonous action upon the fibrillæ, but there is no known means of preventing the same deleterious effect upon the cells of the pulp tissue.

The most valuable escharotics for desensitizing the dentin are:

Phenol.	Trichloracetic Acid.
Zinc Chlorid.	Silver Nitrate.

It must be noted that, while these agents will obtund, the ultimate result is too often produced, with the possible exception of phenol, at the expense of quite as much suffering as they save.

Phenol.—This drug has local analgesic properties besides that of cauterant, and will, therefore, be discussed under another and more important class of agents.

Zinc Chlorid.—Various strength solutions of this drug can be used to advantage in a class of cavities where the decay or softened dentin does not extend too close to the pulp. Zinc chlorid coagulates albumin, and in the process hydrochloric acid is liberated. For this reason the application of strong solutions is painful and should not be employed in deep cavities unless the irritating action of the agent is modified.

This can be done to a marked degree by selecting alcohol and chloroform as the vehicle in which to make the solution.

A useful formula is here given:

℞—Zinci Chloridi,		gr. xx (1.3 gm.)
Alcoholis,		f℥iv (15.0 c.c.)
Chloroformi,	q. s. ad.	f℥j (30.0 c.c.)—M.

Sig.—Apply to the cavity on a small pledget of cotton and gently evaporate to dryness.

Note.—If the zinc salt does not make a clear solution in the alcohol, it indicates that some of the salt has been oxidized; the solution can be cleared by adding one drop of dilute hydrochloric acid.

This is an excellent remedy to apply to the cavity immediately before using compressed air.

Trichloracetic Acid.—In concentrated solution trichloracetic acid causes considerable pain when first applied to a sensitive cavity, therefore defeating the object of its use; but in a 10 or 15 per cent. solution it produces but little pain or inflammatory reaction. In this strength it can be employed, but not always with satisfactory results.

Silver Nitrate.—This agent is perhaps the only known prophylactic drug for decay of tooth-structure. In the posterior part of the mouth where the cementum is exposed to external influences and thus sensitive or in shallow cavities, especially in children's teeth, the use of this drug, in the solid pencil form or in various strength solutions, will be found valuable, both as a means of reducing the sensitiveness and preventing further ingress of caries. As an agent for obtunding the sensitivity of the dentin in an ordinary cavity, it should not be considered for various reasons. When the agent is employed for the purposes above mentioned, the cavity, after the application, should be kept free from saliva for a few minutes, and, if possible, exposed to sunlight, thus decomposing the silver salt as referred to under the subject of *Light* (see p. 235). A solution of sodium chlorid should always be at hand when using silver nitrate, and in case any of the latter agent should accidentally get on the mucous membrane of the patient's mouth, its action can be checked at once by rinsing the mouth with this antidotal solution.

III. LOCAL ANODYNES OR LOCAL ANESTHETICS.

In the judicious use of agents belonging to this class the author firmly believes will ultimately be found the surest and safest road to

success. The following agents, or a combination of two or more, will be found to be of the utmost importance:

Cocain.	Phenol.
Menthol.	Ethyl Chlorid.
Oil of Cloves.	Ether.
Eugenol.	Chloroform.

Cocain.—Both the alkaloid, cocain, and the alkaloidal salt, cocain hydrochlorid, are used in various ways for obtunding sensitive dentin. An important physiologic property of cocain to be remembered here is its power, when applied directly to the mucous membrane or when injected or forced into the pulp tissue, of inducing a condition of analgesia in the part by paralyzing the sensory nerve filaments. In addition to this, it causes a blanching of the part which is subsequently followed by congestion. It should also be remembered that pharmacologists have proved beyond a doubt that cocain is a *general protoplasmic poison;* that muscles as well as nerves and nerve-ends cease to contract or to conduct stimuli when they are exposed to even dilute solutions of the drug. The only reason that the deleterious effect is more noticeable upon nerve than upon other kinds of tissue is that here we are dealing with the medium of sensation and expression.

The author deems it wise to call attention to these well-established physiologic, pharmacologic and pathologic facts, for many instruments have recently been devised for forcing various strength solutions of cocain hydrochlorid, not only into the dentinal tubuli, thereby paralyzing the fibrillæ, but into the pulp proper, anesthetizing this organ as well. In view of these facts, it would appear that we are *never justified in completely anesthetizing the pulp of a tooth for the purpose of painlessly preparing a cavity therein.* Therefore, under the subject of *Cataphoresis* previously referred to, little was written; and for the same reasons, the method of anesthetizing the pulp by *high-pressure anesthesia* for obtundent purposes only will not be considered. Both of these methods will be discussed subsequently under pulp removal.

Cocain and the alkaloidal salt, cocain hydrochlorid, are safe and reliable agents for obtunding sensitive dentin, if confined to the dentinal structure of the tooth. Frequently, in deep-seated cavities, especially in children's teeth, the sensitiveness can be completely overcome by sealing in the cavity for a day or two a creamy paste made by mixing the alkaloid with liquid petroleum. The official *oleate of cocain* can also be used for this purpose. The paste or oleate should cover the

entire surface of dentin which we subsequently expect to excavate. Good results can also be immediately obtained by the use of the following remedy:

℞—Cocainæ, gr. xx (1.3 gm.)
Chloroformi, f℥ij (8.0 c.c.)
Etheris, q. s. ad. f℥j (30.0 c.c.).—M.
Sig.—After the rubber dam has been adjusted, apply to the cavity on a small pledget of cotton and evaporate to dryness.

In the use of this remedy, advantage is taken of the physical law previously referred to in connection with *Cold*. As the volatile liquids, ether and chloroform, evaporate, a certain amount of heat is abstracted from the tooth-structure, and a coating of the alkaloid, driven to an extent into the dentin, is left in the cavity. This remedy will not completely obtund all sensitive dentin, but its use will be a material aid.

There can be no objection in favorable cases, provided the dentin has been previously sterilized, to using aqueous solutions of cocain hydrochlorid with uniform pressure over the entire area of the cavity, thus forcing the anesthetizing solution an equal distance into the dentin. This is an extremely difficult thing to do without forcing the solution at some more favorable point in the cavity through the tubuli and into the pulp. However, there are cavities where good results can be accomplished by the careful use of this method. In some cases of gingival cavities good results can be obtained by hypodermically injecting a 1 or 1.5 per cent. solution of cocain hydrochlorid into the pericemental membrane somewhere near the apex of the root. This practice should not be generally recommended.

Menthol.—This drug can be substituted for the cocain in the above prescription with ether and chloroform, and used in exactly the same manner. An oily liquid (mentho-chloral) can be formed by heating together over a water-bath or rubbing in a mortar, an equal amount of menthol and chloral. This remedy will be found efficacious by sealing in the cavity for a few days.

Oil of Cloves.—A profound analgesic effect can be produced upon sensitive dentin, especially in deep-seated cavities, by using oil of cloves and heat in the following manner as suggested by Dr. C. N. Johnson: After carefully desiccating the dentin by means of warm alcohol and gentle heat, a pledget of cotton saturated with oil of cloves should be placed in the cavity and a current of heated dry air directed thereon until the cotton is nearly dry. This should be repeated as often as the case demands.

Eugenol.—Eugenol is the chief constituent of oil of cloves and can be used in the same manner as the latter drug as above described.

Phenol.—This drug can be substituted, with equally good results, for the oil of cloves or eugenol, as described in the foregoing method. Care should be taken here, however, in directing the heated air so as not to cause the fumes of phenol to escape on the patient's face. Oil of cloves, eugenol, and phenol are three true *local anodynes*, and any one of which, if hermetically sealed in a cavity for a few weeks, will check the continued irritation of the fibrillæ and pulp, thus aiding Nature to restore these structures to their normal condition when they should not be responsive. The author's phenol compound (see p. 273) is an excellent remedy for this latter purpose. By this means, then, the sensitiveness of the dentin can also be allayed.

Ethyl Chlorid, Ether, and Chloroform.—These agents, by their rapid volatility, produce a condition of analgesia, thereby obtunding sensitive dentin, as previously explained under *Cold*.

IV. GENERAL ANODYNES OR ANALGESICS.

In order to do permanent work for certain highly nervous patients, it is sometimes necessary to resort to the administration of this class of drugs. The agents largely used for this purpose are:

Opium.	Nitrous oxid.
The bromids.	Chloroform.

Opium.—This drug is a most powerful analgesic, and while there are some dental conditions where it or its chief alkaloid, morphin, is truly indicated, the drug ought not, in the author's judgment, to be given for the treatment of sensitive dentin.

The Bromids.—The bromids of potassium, sodium, and ammonium are valuable drugs in certain cases. Perhaps there is no drug which will quiet a nervous patient more readily, when the nervousness comes purely from fear or dread, than potassium bromid, which is the representative of this class. In such cases, where it is deemed necessary, the following prescription will prove helpful:

℞—Potassii bromidi,	ʒjss (6.0 gm.)
Syrupi sarsaparillæ comp.,	f℥iij (90.0 c.c.)—M.

Sig.—Take a tablespoonful in water after meals the day before coming to the office.

Nitrous Oxid.—There are several apparatuses on the market by which nitrous oxid gas can be administered through the nose. It is possible with such an apparatus to carry the patient just to the

analgesic stage, and hold him under its influence until a sensitive cavity has been painlessly prepared. Oxygen, in proper proportions, is generally mixed with the anesthetic agent for this purpose, as it overcomes the cyanosis which frequently follows the prolonged use of nitrous oxid alone. In cases where the operator feels that it is necessary to resort to this method, good results can be accomplished.

Chloroform.—With the patient in the upright position, chloroform can be carried to the analgesic stage and sensitive cavities prepared. Most authorities agree, however, that chloroform should not be administered unless the patient is in the recumbent position, and that the analgesic stage is the most dangerous. Death has been known to occur suddenly after a few inhalations in cases of marked idiosyncrasy against the drug.

Hewitt, De Ford, and others report excellent results from the use of chloroform in the manner described above. In selected cases the author has used the method with uniformly good results; but the general use of the drug in this manner is not advised.

In closing, may I say that most patients who repose *confidence* in the operator, are sensible and are willing to stand some pain in the preparation of cavities in their teeth. With confidence, a true running engine, a steady hand, a sharp bur, and with the aid of some of the many remedies herein suggested, the operator ought not to expect nor to ask the patient to stand more than a small amount of pain in the preparation of the most sensitive cavity.

EXPOSED OR NEARLY EXPOSED PULPS.

GENERAL CONSIDERATIONS.

In the practice of dentistry there are problems continually arising, wherein it is difficult for the conscientious operator to decide upon a method of procedure which will conserve the best interests of the patient. There is no condition confronting us with greater difficulty of treating than in those cases where the decay has extended to such a depth that its thorough removal will expose or nearly expose the pulp. The problem to be solved here in all such cases is to decide whether it will be best to try to save the pulp or to anesthetize or devitalize this organ, remove it, and subsequently fill the canals.

Factors to be Considered.—There are several important factors to be considered, and upon which will largely depend the success or failure following an attempt to save the pulp after it has actually been exposed. In an accidental exposure in the preparation of a cavity, the chances for saving the pulp, provided the injury has not been too great, are far more favorable than if the pulp had been exposed by the necessary removal of the carious dentin. Our success will also depend in no small degree upon the condition of the pulp as well as upon the general condition of the mouth of the patient in which the exposure occurs. In cases of hyperemia of the pulp an effort should be made to determine whether it is active or passive hyperemia, and where pulpitis is present our prognosis will be governed largely by ascertaining whether the pulpitis is partial or complete, or of the nonseptic or septic variety. If there is congestion or any evidence of degeneration of the structural components of the pulpal organ itself, it would be futile to attempt to cap it. Logan is of the opinion that most pulps, the exposure of which has been brought about by caries, have undergone sufficient inflammatory changes to cause their ultimate death, even when carefully capped. Any attempt to permanently save an exposed pulp in the mouth of a patient who was suffering from some systemic derangements interfering with the general circulation, thus lessening vital resistance, would doubtless result in failure also, for in such cases the pulp would fail to receive from the blood supply the necessary elements for the restoration of its functional activity. The general condition of the mouth itself and the care it receives daily from the patient, is an essential factor to be taken

into consideration before proceeding to cap a pulp; for Hopkins, of Boston, in a carefully conducted series of experiments to ascertain the difference in virulency of certain pathogenic bacteria in different mouths, and in the same mouth under different conditions, proved that not only did the germs proliferate more rapidly in neglected and uncared-for mouths, but their pathogenic properties are greatly increased.

Exceptional Cases of Exposure.—There is one class of cases of pulp exposure which frequently present in a busy practice and in which it is our plain duty to make the attempt to restore the organ to its normal function, even though the conditions for doing so are not altogether favorable. I mean here those cases in the mouths of young patients where the pulp is exposed from decay and the roots of the tooth have not been fully developed. Every effort should be made to cap such a pulp, providing the clinical symptoms are at all favorable, and thereby save it, if for only a year or two; for experience has demonstrated that to remove the pulp and properly close the large openings in the end of the roots is, at best, a difficult procedure; that a tooth in this condition, thus treated, is usually a source of annoyance and its usefulness generally of short duration.

In another class of cases the author also believes that we are justified in capping the pulp. For instance, in those cases of exposure where for certain reasons it is desirable to save the tooth, and on which it would be difficult to adjust the rubber dam, aseptically remove the pulp, and throughly fill the canals. I wish to state here, however, that I do not mean to infer that a pulp should be capped in an anterior tooth, because of the liability of the tooth-structure discoloring after the pulp has been removed. This phrase of the subject will be referred to in detail subsequently under the Preservation of the Color of the Tooth in Pulp Removal.

From the foregoing, then, it should readily be understood that no set of rules can be given, the application of which will surely lead to success. Every case must be studied and treated according to the pathologic conditions found and the operator's best judgment, after having taken into consideration all these various factors.

THERAPEUTICS OF PULP CAPPING.

These are several methods of capping the pulp, each differing in minor details, such as the use of various cements, gutta-percha, concave metallic disks, etc., etc. The reader's attention will first be directed to the general precautions to be taken in following the different methods of capping; after which one method will be described

in detail which has proved successful in the author's practice. By this I do not mean to convey the idea that all pulps which I have attempted to save have been rehabilitated to their functional activity—many have not; however, a sufficient number of those thus treated have remained quiet, and proved years later to be vital, to justify making the attempt where the case demands.

Precautions.—The precautions to be observed in following any method are:

1. By the use of an anodyne, the hyperemic pulp, if in this condition, *must be restored to normal* before the final capping.

2. The dentin overlying the pulp *must be thoroughly sterilized.* It should be noted here that the usual perfunctory method of sterilizing the dentin by simply applying a germicidal solution to the cavity for a few moments does not sterilize to the degree necessary for successful results. The lack of thorough sterilization has, without doubt, been the chief cause of failure in many instances. The accuracy of this statement will be seen when we remember that our greatest success has followed the capping of pulps which have been accidentally exposed with a bur or instrument in preparing a cavity, although, in most cases, greater mechanical injury had been caused than when the exposure was due to caries or the removal of carious dentin.

3. Pressure in applying the material for capping, or the cement which covers the capping, *must be avoided.*

Technic.—After breaking down all overhanging edges of enamel and removing as much of the débris and softened dentin as can be done without pain or injury to the pulp, the cavity should be flooded with a mild, nonirritating, antiseptic solution, previously heated to the temperature of the body. For this purpose the author suggests the use of one of the following remedies:

℞—Phenolis, f℥ss (2.0 c.c.)
Aquæ menthæ piperitæ, f℥vj (180.0 c.c.)—M.
Sig.—Use wherever a mild, non-irritating antiseptic solution is indicated.

℞—Alcoholis, ℥j (4.0 c.c.)
Aquæ cinnamomi, f℥vj (180.0 c.c.)—M.
Sig.—Use as a spray.

These solutions can be used as a spray or with a water syringe before applying the rubber dam, thus adding comfort and cleanliness to the operation. The excess can now be absorbed from the cavity with cotton and the dam adjusted. By using some obtunding remedy

and a sharp spoon excavator, or oftentimes a large round bur in the engine, the carious dentin can be removed. If, however, the thorough removal of all the discolored dentin would make a large exposure, it is best to leave the layer overlying the pulp and depend upon the sterilizing agent, rather than to jeopardize the life of this organ by the injury thus produced. The delicate pulp tissue will not tolerate much abuse and remain quiet, therefore if it is injured to any great extent it had better be removed at once. The dentin can now be sterilized by sealing in the cavity, for a week or two, the following remedy which is not only germicidal in action, but possesses marked anodyne properties as well:

℞—Mentholis,	gr. xx (1.3 gm.)
Thymolis,	gr. xl (2.69 gm.)
Phenolis, (U. S. P.)	f℥iij (12.0 c.c.)—M.

Sig.—Use as directed.

For convenience this remedy has been called *phenol compound.*

It is best to seal with a veneer of quick-setting cement, previously filling most of the cavity with cotton, thereby avoiding pressure and facilitating the subsequent removal of the dressing. By this means the dentin can be thoroughly sterilized, and the pulp, if at all hyperemic, as it is likely to be, will return to its normal condition.

Many pulps have been irritated by the injudicious use of gutta-percha for sealing in dressings temporarily or for separating purposes where proximal cavities exist. Unless due care is taken, even where the cavities are not deep, infectious material or the medicine is liable to be forced through the dentin and into the pulp. Cement had better be used for temporary sealing purposes, and before separating with gutta-percha the cavity should be cleaned of débris and sterilized.

Thymol has a peculiar but favorable action on animal tissue, and for this reason it is incorporated in the above prescription. At the next sitting, the case giving a favorable history for the interval, the dam should always be applied, the teeth included sterilized, and the previous dressing carefully removed, when the exposure and dentin immediately over the pulp can be gently covered with a thin paste made by mixing *thymolized calcium phosphate* with oil of cloves or eugenol. A prescription for the thymolized calcium phosphate follows:

℞—Thymolis,	gr. x (0.6 gm.)
Calcii Phosp. ppt. (purificata),	℥j (32.0 gm.).—M.

Sig.—Use as the powder for making paste.

The paste should be placed on one side of the cavity and gently coaxed over the exposure in such a manner as to exclude the air. I desire to emphasize the importance of covering the entire dentin immediately over the pulp, as well as the exposure, with this antiseptic and non-irritating paste. By this means we prevent the phosphoric acid of the cement, used to cover the paste and to temporarily fill the cavity, from irritating the pulp. It should be understood that this paste is only intended as a nonirritating, antiseptic covering for the pulp. *It does not set.* To bring about "setting," it would be necessary to use a substance for the powder and an acid for the liquid which react upon each other. This would cause irritation, thus defeating our object. It is best, as intimated here, to fill the entire cavity with cement and wait for a few months or perhaps a year before inserting the permanent filling or inlay; and even then we should be certain that the vitality of the pulp has been retained, for frequently exposed pulps, under the most careful treatment, gradually die without any objective symptoms. The fact that the tooth has given no trouble should not be taken as evidence that the pulp is alive, for the reverse is too often true—the drugs in the capping material keeping the tissue, though dead, from undergoing decomposition for months and sometimes for years.

Every advantage should be taken to prevent all possible means of subsequent irritation to the pulp. For this reason the author uses precipitated calcium phosphate instead of calcined zinc oxid, which latter substance is recommended by many writers. The powder (largely zinc oxid) which comes with a package of cement is supposed to be chemically pure. Those who are familiar with the science of chemistry, however, know that arsenic is found associated in nature with many of the metals, among which is zinc; and, while it can be done, it is difficult to obtain these metals or their oxids free from arsenic. It is well in those cases where the pulp is not quite exposed, to add a small amount of either *aristol* or *europhen* to the paste. These are iodin compounds and are used as substitutes for iodoform. Both are tasteless, practically without odor, and insoluble in water, but soluble in the *oil* used as the vehicle for the paste, therefore only a small amount should be added.

I desire to emphasize the importance of studying carefully the conditions as found in each case; and to say that the opportunity here for exercising good judgment is very great, and that there is a satisfaction in realizing, whether we succeed or fail in our effort to save the pulp, that we did our duty as we saw it.

THE REMOVAL OF PULPS AND SUBSEQUENT TREATMENT.

GENERAL CONSIDERATIONS.

Embryologists claim that when the roots of a tooth are fully developed, the pulp has no further function to perform. If this theory can be accepted as correct, and I think that it is quite well established, it would appear from the large percentage of failures following the most careful methods of pulp capping, that the safest and, therefore, the best practice would be *to destroy the vitality and remove the pulp* in all cases where this delicate and susceptible tissue had been previously irritated for any great length of time, unless, as explained under Exposed or Nearly Exposed Pulps, there was some special reason for attempting to restore the organ to its functional activity. From sad past experience the author has been led to adopt this general practice. By this I do not wish to convey the idea that it is advisable or necessary to injudiciously or ruthlessly destroy pulps, for such is not the case. It is the plain duty of every dental practitioner to save the pulps of teeth, if it can be done with any reasonable degree of success. There are many conditions, some of which are pathologic and others are not, which necessitate the removal of the pulp, such as:

1. *Dental caries.*—In those cases where dental caries has encroached upon the pulp to the extent of producing passive hyperemia or true inflammation, especially the latter disease. The pulp here oftentimes has been invaded by pathologic bacteria, and frequently the tissue has absorbed poisonous ptomains. This is perhaps the most prolific source of pulp irritation.

2. *Mechanical irritation.*—This is due to such cases as abrasion, thermal changes, close proximity of metallic fillings, injudicious regulating, excessive grinding, etc.

3. *Calcific deposits.*—This includes pulp nodules, partially calcified pulps, and secondary dentin. These calcific deposits result from slight but continued irritation of the pulpal organ.

4. *Crowning teeth and filling large cavities.*—It is usually difficult to grind a vital tooth sufficiently to adjust the band for a crown properly without irritating the pulp and thus endangering its life. Sometimes in filling teeth it is advisable to remove the pulp in order to properly anchor a large filling or inlay.

5. *Pyorrhea alveolaris.*—Frequently in treating this disease, where the teeth are acutely sensitive or where the pockets are deep and the infection in the apical area has left the pulp in a low state of vitality, the best results can be accomplished by removing the organ.

General Factors to be Observed in Removal of Pulp.—Having considered all of the conditions and deciding that the removal of the pulp is indicated, the method by which this can be accomplished with the least inconvenience to the patient and to the operator is the most important consideration. Whatever method is employed in the removal of pulps from teeth and the subsequent treatment, there are at least three factors to be observed, viz.:

1. Establish and maintain asepsis in performing the operation.
2. Preserve the color of the tooth.
3. Thoroughly fill the root.

There are two general methods employed in the removal of pulps—*anesthetization* and *devitalization.*

I. ANESTHETIZATION.

In the author's opinion a very satisfactory method of removing pulps from teeth, to both patient and operator, all things considered and conditions being favorable, is to anesthetize the tissue by the use of various strength solutions of local anesthetic agents. The solutions are forced or carried through the dentin and into the pulp by means of pressure or the electric current.

1. **PRESSURE ANESTHESIA.**—By pressure anesthesia is meant the process of anesthetizing the pulp by forcing solutions of local anesthetics, usually cocain hydrochlorid, into the tissue by means of pressure. The pressure is applied either by using unvulcanized rubber or gutta-percha, and a blunt instrument, or by specially devised instruments for this purpose. There are many such instruments on the market; and while they are often an aid in accomplishing the ultimate result, they are not an absolute necessity.

Sterilization.—The rubber dam should be employed in every case where it is possible to adjust it, and the teeth included sterilized. In cases where the dam cannot be adjusted, it would doubtless be best to remove the pulp by the devitalization method, to which reference will be made later, for in using the method under consideration care must be taken to prevent pericementitis following the operation; and one of the precautions to be observed in preventing this result is to *thoroughly sterilize* the cavity before applying the pressure. It should be remembered that the majority of canals which contain live pulps are

sterile, generally speaking, and if they become septic at any time before the root is filled, it is the fault of the operator. Thus the importance of always adjusting the rubber dam, using sterile instruments, and having in a convenient and conspicuous place an antiseptic doily on which to wipe the blood and dry the instruments used.

Attention is again directed to the fact that the usual custom of applying coagulating agents, such as phenol, cresol, etc., to the cavity for a few seconds does not sterilize the dentin to the degree desired. The best results are accomplished by employing germicidal agents which are soluble in water. In cavities where the decay is not too deep, the dentin can be sterilized by the use of a 10 per cent. solution of formaldehyd to which 5 per cent. of sodium borate (borax) or sodium carbonate has been added. Where the decay is near the pulp this solution is liable to cause pain, in which case the same result can be accomplished by the use of a 1: 500 solution of mercury bichlorid or a 1: 200 solution of sublamin. In using the latter solutions the pliers on which the remedy is applied should be wiped immediately on an antiseptic doily to prevent the mercury from acting upon the instrument. One of the best solutions with which to chemically sterilize the dentin, especially in those cases where the cavity has previously been filled and the tubuli are closed and perhaps there is secondary dentin, is a 25 per cent. solution of sulphuric acid. Cook recommends using pure sulphuric acid for this purpose. The solution can be applied to the floor of the cavity, being careful not to get the agent on the crown of the tooth. After a few minutes the excess can be neutralized with a solution of sodium bicarbonate. After the dentin is sterilized the cavity should be desiccated with warm alcohol and gentle heat, when we are ready to use the anesthetizing solution. Before taking up the technic of this method, however, I desire to again emphasize the importance and necessity of cavity sterilization. In our discussion later of the devitalization method, it will be pointed out that the carious and infected dentin can be completely and painlessly removed after the devitalizing agent has been applied, thus *mechanically* sterilizing the cavity; but in the anesthetization method the infected dentin is sensitive and cannot be removed without unnecessarily producing pain. The dentin in this case must, then, be sterilized by *chemic* means, for to force the anesthetizing solution through the dentin without previously sterilizing it, means the forcing of microorganisms and perhaps poisonous ptomains into the pulp tissue and many times into the tissue surrounding the apical end of the root, for it is difficult to force the solution to, and only to, the apex; thus too much pressure and the lack

of thorough sterilization constitute a prolific source of pericementitis following the removal of pulps by this method.

The Solution.—With the cavity thoroughly sterilized we are now ready to use the anesthetizing solution, which should be made at the time. For this purpose the crystals, previously powdered, or flaked cocain hydrochlorid should be used as the base, and freshly distilled or boiled water as the vehicle. In my own practice I use "cocain points," which are compressed points or cylinders of pure cocain hydrochlorid containing 1/12 grain (.005 gm.) each, as the base and my regular local anesthetic solution as the vehicle for making the stronger solution. A prescription for the regular local anesthetic solution here follows:

℞—Cocainæ hydrochloridi,	gr. v (0.3 gm.)
Sodii chloridi,	gr. j (0.06 gm.)
Phenolis,	m. ij (0.13 c.c.)
Aquæ menthæ piperitæ,	f℥j (30 c.c.)—M.

Sig.—Use as a local anesthetic for hypodermic injections.

There are many advantages in using the anesthetic agent in cylinder form. The exact amount of the drug used is known, the points are readily soluble and, in many cases, they can be conveniently placed in the sterile cavity and dissolved therein, either in the serum of the blood, if an exposure exists, or in the vehicle used for this purpose. There is no advantage in using the above solution over distilled or boiled water or freshly prepared peppermint water, except that the solution is always at hand in a convenient container and is sterile.

The thumb and forefinger with which cotton is to be wrapped around the broach should be sterilized by dipping a large pledget of cotton in 10 per cent. formaldehyd, or 1:500 mercury bichlorid, or 1:200 sublamin solution, and rolling this between the thumb and finger. A cocain point or a small amount of the flaked cocain hydrochlorid is now placed on a clean glass slab and a pledget of cotton, dipped in the vehicle selected, a few drops of which have previously been placed on one end of the glass slab or in a clean glass watch-crystal or other container, is gently placed in contact with the alkaloidal salt, when the latter readily dissolves, making a strong solution. It is never necessary to make a saturated solution, for oftentimes better results will be obtained, especially if the solution is to be forced through the dentin, if the strength of the solution approximates only 4 or 5 per cent. If an exposure exists, as stated above, the point can be placed directly in contact with the pulp and be dissolved in the blood-serum.

Pressure.—The cotton thus saturated is placed in the cavity as

nearly over the pulp as possible. A piece of unvulcanized rubber which will approximately fill the cavity is selected and passed through the flame. There are two objects in doing this: It sterilizes the rubber and also makes it more pliable, in which form it conforms readily to the cavity of the tooth. The rubber is now placed in the cavity, and by means of gentle but firm pressure with a suitable blunt instrument the solution is forced through the dentin and into the pulp. If there is any evidence of pain as the pressure is applied, it should be stopped for a moment, but never released. The slight pain is only momentary and is an indication that the solution is being confined under the pressure, which is essential for the success of this method.

It may be necessary in those cases where there is considerable dentin between the cavity and the pulp to make two or three applications before the pulp is reached without pain, after which one application should complete the thorough anesthetization of the organ. After the first application a small depression can be drilled into the dentin toward the pulp, in which the solution can subsequently be placed, thereby aiding materially in confining the solution under the pressure. When an exposure exists, it requires but little pressure to anesthetize the pulp. In these cases the cocain point can be placed in the cavity near or over the exposure and the pulp gently pricked with a sharp explorer, causing it to bleed; this, if done carefully, will produce very little pain. The blood-serum will dissolve the cocain hydrochlorid, when pressure can be applied and the pulp anesthetized. In doing this, however, there is greater danger of forcing the blood into the tubuli of the dentin of the crown of the tooth, thereby making it more difficult to remove the blood. Care should also be taken not to force the solution any further than is necessary for the painless removal of the pulp, for it should be noted here again that cocain is a general protoplasmic poison, and if even weak and sterile solutions are forced past the apices of the roots pericementitis is almost sure to follow.

Confining the Solution Under Pressure.—In removing pulps by pressure anesthesia without employing instruments devised for this purpose, the best results are obtained in cases where there are four walls to the cavity, for in this condition the solution is easily confined under the pressure. In proximo-occlusal cavities, the missing wall can be built temporarily with gutta-percha or cement. This is seldom necessary, however, if, in packing the rubber in the cavity, care be taken to cover the gingival wall first and thus seal at this point, then working the rubber over the occlusal and gradually creating the pressure. Whatever means is adopted for the

purpose of confining the solution, we must avoid having the solution escape at the gingival margin of the cavity and thereby be forced into the gum tissue and pericemental membrane. The cause of much pericementitis following this method of removing pulps can be traced to carelessness or ignorance in this regard.

As stated elsewhere, there are many ingeniously devised instruments on the market, the use of which is often a material aid in confining the solution under pressure and forcing it through the dentin. The same precautions should be observed in using any of these instruments as have been emphasized in the application of pressure by other means.

Opening the Pulp Chamber to Expose Canals.—When the pulp is anesthetized, the pulp chamber should be opened into in such a manner as to expose the canals. This is best accom-

FIG. 3.

FIG. 4.

FIG. 3.—This skiagraph, taken by Ream, shows that the dentist, in opening into the lower first molar, drilled through the floor of the pulp chamber and exposed the tissue between the bifurcated roots; and, as a result, an abscess subsequently developed. The case was treated by sterilizing and stimulating the necrotic area between the roots with phenolsulphonic acid, subsequently flowing eucapercha compound over the puncture and packing firmly with warm base-plate gutta-percha.

By observing the second molar shown in this skiagraph we notice the unusually small amount of tooth-structure between the floor of the pulp chamber and the bifurcation of the roots; yet it is unnecessary to have the result as shown in the first molar.

FIG. 4.—This skiagraph illustrates another case where the dentist drilled through the floor of the pulp chamber and exposed the tissue between the roots of the lower second molar. The skiagraph shows that the canals were practically obliterated. The case was referred and treated by sealing phenol compound in the cavity, against the exposed tissue for one week, after which the floor of the cavity and puncture was covered with eucapercha compound and warm base-plate gutta-percha pressed firmly over the puncture. This was covered with cement and an inlay inserted.

plished with a large round or inlay bur by means of which the entire roof of the chamber can be obliterated. In opening into the pulp chamber of the molar teeth care should be taken not to disturb the floor or walls of the chamber; for by so doing we are liable to drill through the bifurcation or the mesial or distal surface of the roots. Even if such disastrous results do not follow the destruction of the floor or walls of the chamber, it at least adds to the difficulty of entering the canals with a broach. (See Figs. 3 and 4.) While we are never

justified in drilling unnecessarily for the purpose of freely exposing the canals, it is, if necessary, far better to weaken the crown of the tooth somewhat by this means rather than leave a portion of the pulp in an inaccessible canal which may decompose and subsequently cause an abscess.

Selecting and Testing Broaches.—The selection of a proper broach is an important matter. Every broach should be tested before entering the canal. This can be done by bending it in various directions. If the broach is weak in any particular place it can be detected by this means; thus we avoid breaking the broach in the canal, the removal of which is often a difficult procedure. Many good operators claim to be able to remove all pulps by using a smooth, three-cornered broach on which a few threads of cotton are wound. Others use twist or spiral broaches. In all large canals the author has had the most satisfaction from the use of a barbed broach. The broach should be gently worked along the side of the canal as far as it will go without using too much force, twisted once or twice to entangle the pulp, and then withdrawn. By this means the pulp can be removed from large canals in its entirety. In inserting the broach into the canal, care should be exercised so as to avoid pushing the tissue before the broach and thus packing it into the apical area, where it is difficult of removal. Many root-canals have been imperfectly filled and abscesses subsequently developed, because of the failure to remove all of the pulp tissue at the time it was anesthetized or devitalized.

Control of Ordinary Hemorrhage and Removal of Blood.—In the removal of live pulps by the anesthetization method, there necessarily would be more hemorrhage than in those cases where the pulp was devitalized before attempting to remove it. However, the control of hemorrhage is not as difficult a procedure as many writers have led us to believe. In most cases the hemorrhage, if undisturbed, will be checked by Nature's method in a few minutes, after which the blood in the cavity and canal should be *thoroughly removed.* I desire here to emphasize the importance of *removing the blood.* One of the factors to be observed in extirpating pulps from teeth and the subsequent treatment, is to *preserve the color of the teeth.* The cause of many teeth darkening after the pulp has been removed can be traced directly to the failure to remove the blood from the dentin of the crown of the tooth. The far too prevalent practice of wiping out the bloody canal with a solution of hydrogen dioxid, blindly thinking the blood can be removed by this means, cannot be too strongly condemned. The hydrogen dioxid simply decomposes the blood within the tooth-

structure, oxidizing the iron of the hemoglobin; and the gases evolved in the decomposition force this pigment into the tubuli, which, if left (and it is difficult to remove it), will cause the tooth to darken in almost every instance. Therefore, we should avoid forming within the tooth-structure a pigment which we know will discolor teeth. *The color of a tooth does not depend upon the life and vitality of the pulp, but upon the array of colors in the dentin which are reflected through the nearly colorless and transparent enamel.* If, then, these colors are not changed by our failure to remove the blood or by the use of staining remedial agents in the subsequent treatment following pulp removal, the tooth will not discolor.

To remove the blood from the canal, alcohol can be used, or even better than this agent is Nature's greatest solvent, water. The water should, of course, be sterile, and the same specimen can be employed here as was used in making the anesthetizing solution, *i.e.*, freshly distilled or boiled water, or peppermint water to which two minims (0.12 c.c.) of phenol has been added to the fluidounce (30.0 c.c.). If convenient, a little sodium chlorid (common salt) can be added to the water. By this means the blood can be completely *removed*, not decomposed in the canal and forced into the structure of the tooth.

Small Canals.—There are many canals so small and tortuous that even a fine broach will not enter, to any depth at least. In these cases, after the hemorrhage from the larger canals has been checked and the blood removed it is well to stop the mouth of each with cotton or temporary stopping, when the pulp tissue in the small canals can be disorganized by the use of strong solutions of mineral acids or alkalies. The author prefers making a paste of sodium dioxid and absolute alcohol, placing the paste in the pulp chamber over the small canals, and working it down as far as possible with a smooth broach. The alcohol gradually evaporates, when the sodium dioxid can be decomposed into oxygen and caustic soda by placing a pledget of cotton in the cavity moistened with distilled water. After the reaction has taken place, the alkali can be neutralized with a weak solution of sulphuric acid (2 per cent.). This process can be repeated until the desired end is attained. There are other means by which the same results can be accomplished, such as the use of a 50 per cent. solution of chemically pure sulphuric acid, phenolsulphonic acid, strong solutions of potassium or sodium hydroxid, or a mixture of metallic potassium and sodium (Schreier's paste). These same agents can be used to advantage for the purpose of disposing of a remnant of a pulp in larger canals. It is not safe to anesthetize this remnant by means of

pressure. The only cases on record to my knowledge, where toxic symptoms have resulted from the removal of a pulp by pressure anesthesia, followed an attempt to anesthetize a remnant of a pulp or in making the second application of the anesthetizing solution.

After-Treatment.—After the pulp has been removed and the canals dehydrated with alcohol and heat, an *anodyne* treatment is indicated. For this purpose such drugs as phenol, oil of cloves, or eugenol can be employed. The author suggests here phenol compound, to which attention was called under Exposed or Nearly Exposed Pulps. In using any of these remedies, especially the last-named, it is best to insert dry cotton in the canal and then place a pledget dipped in the remedy in the pulp chamber and seal with cement or temporary stopping. The dry cotton in the canal will absorb the moisture from the apical end of the root and the anodyne remedy from the pulp chamber. There is an advantage in using the dry cotton, for it is almost impossible to completely dehydrate the canal at this sitting. If asepsis has been maintained in removing the pulp, all that is necessary is to keep the canal in this condition until the root can be filled; therefore, only a very small amount of the remedy should be used. The tendency here is to use too much with the frequent result of a mild active hyperemia in the pericementum. This condition, of course, soon subsides, but it is always best to prevent it when possible.

When to Fill Canals.—The canals should not be filled at the sitting at which the pulp has been removed by pressure anesthesia, unless there be some exceptional reason for doing so. There are many good reasons why the canal should not be filled at this sitting:

1. While it is our object to force the solution just sufficiently to anesthetize the pulp, our main object is to remove the pulp *absolutely without pain;* and it is very difficult to force the solution to the end of the root without forcing it through the apex to some extent and anesthetizing the tissue in the apical area. With the tissue anesthetized, we would have no guide as to when the root was thoroughly filled.

2. The tearing away of the pulp from its connection at the apex causes more or less irritation, and a few days should elapse to give Nature a chance to readjust the condition. The root filling would only serve at this time to further irritate the tissues.

3. Sometimes with the utmost care in removing the pulp, secondary hemorrhage ensues with the formation of a clot in the apical area, causing soreness, in which case greater comfort can be given the patient by the proper treatment through the root-canal than simply by counterirritation or external treatment only.

At the second sitting, the case giving a favorable history, the canals should be filled.

Excessive Hemorrhage.—There are cases occasionally where Nature does not stop the hemorrhage as readily as we desire. In these exceptional cases the hemorrhage must be stopped by artificial means, even at the possible expense of producing pericementitis. Cauterizing agents are useful here. For this purpose 95 per cent. phenol or, what is still better, a 50 per cent. solution of phenolsulphonic acid can be worked down into the canal against the injured and bleeding tissue, after which the acid should be neutralized and an anodyne treatment employed as usual. Where the above treatment does not produce the desired result, cotton saturated with a fresh 1:1,000 solution of adrenalin chlorid can be placed in the canal and with unvulcanized rubber forced into the tissue beyond the end of the root. This agent should only be used in extreme cases because of the soreness and injurious effect it is liable to produce upon the tissues affected.

Objections to the Use of Adrenalin Chlorid.—In this connection I desire to discuss the use of solutions of adrenalin chlorid as the vehicle for making the anesthetizing solution, or the use of adrenalin chlorid and cocain hydrochlorid tablets for anesthetizing the pulp. The adrenalin chlorid has been suggested as a means of *preventing* hemorrhage. Now, it ought to be evident to anyone who has studied this subject that to prevent hemorrhage by the use of any hemostatic agent, it is necessary to force the agent into the tissue from which the hemorrhage comes. Therefore, to get the effect of the adrenalin chlorid in removing pulps by pressure anesthesia, it is absolutely essential that the anesthetizing solution, which also contains the hemostatic agent, be forced through the apex and into the apical area—the very thing we have been taught, from sad experience, not to do. When we remember that the majority of pulps we are called upon to remove are those in which there is, or has been, more or less pulpitis, and when we remember also that pathology teaches that this condition is frequently associated with pericementitis, it is questionable whether or not we ought to prevent hemorrhage in removing pulps from teeth. For to permit the escape of blood from the hyperemic tissue at the end of the root is one of the best means of aiding nature to readjust the abnormal to the normal condition. In case the primary hemorrhage has been prevented by the use of hemostatic agents, such as adrenalin chlorid, secondary hemorrhage is almost certain to follow with the formation of a clot, the absorption of which in the apical area is an extremely slow and tedious process.

2. **CATAPHORESIS.**—Cataphoresis, as has been elsewhere explained, is a term applied to the process of carrying medicinal agents in solution into the various tissues and organs of the body by means of the electric current. There is a variety of cataphoric outfits on the market. To anesthetize a pulp by this means the tooth should be insulated by the rubber dam, care being taken that no moisture escapes from the gum. A small pledget of cotton saturated with the anesthetizing solution is now placed in the cavity, the positive pole, or anode, applied to the solution, and the negative pole, or cathode, moistened with water, applied to some part of the patient's body, usually the hand, thus completing the circuit. A steady and continuous current is desired, and the perfected instruments are so devised that the amount of current can be measured. The time required to anesthetize the pulp by this means depends largely upon the density of the dentin and the perfection of the instruments used. With the pulp anesthetized, the same method of removing and the subsequent treatment is followed as in pressure anesthesia. Cataphoresis, while successful in the hands of those who mastered the technic, never became popular, largely because of the time required to accomplish the result and because of the complicated and expensive apparatus necessary.

If the method of anesthetizing the pulp be followed and the precautions observed as detailed here, it will be found that there are few pulps which will not yield to the influence of cocain hydrochlorid. It takes time, however, to adjust the rubber dam, sterilize the cavity, remove the pulp and blood from the canal and seal in the anodyne remedy. Many times the operator is not able at this sitting to give the necessary time to complete this operation. There are cases also where the condition or the location of the tooth in the mouth is such as to make the removal of the pulp more favorable by another method which will now be considered.

II. DEVITALIZATION.

In discussing Sensitive Dentin under the subject of escharotics or caustics, reference was made to the fact that there were many drugs belonging to this class of agents that could not be employed in the treatment of sensitive dentin, for the reason that they were penetrating and had the same deleterious effect upon the cells of the pulp tissue as upon the dentinal fibrillæ. Some of the agents which cannot be used for allaying the sensitiveness of dentin are exceedingly valuable and are employed for the purpose of destroying the vitality of the pulp, thus

aiding in its painless removal. The most prominent of these agents is *arsenic trioxid* (As_2O_3), formerly called arsenious acid. The agent was first advocated to be used in the treatment of sensitive dentin by Dr. Spooner, of Montreal, who discovered that by sealing the drug in a cavity for a few days the most sensitive dentin yielded to its influence. The fact, however, that nearly all teeth thus treated subsequently gave trouble because of the death of the pulp and the usual sequelæ, led the profession to abandon this agent for the purpose for which it was introduced; but it has ever since been used as a means of destroying the vitality of the pulp. In fact, for years it was the only agent employed with any satisfaction.

The Preparation.—There has been much difficulty experienced in the use of arsenic trioxid, largely because of the uncertainty of the preparations employed. Many arsenical preparations are on the market. The white powder can be used by moistening a small pledget of cotton with some liquid, such as phenol, cresol, creosote, or oil of cloves, then by touching the cotton to the powdered arsenic trioxid, a sufficient amount will adhere which should be transferred to the cavity and sealed, preferably with cement. It is well for each operator to select an arsenical preparation with which he can obtain good results, and then this should be used to the exclusion of all others. By this means only can we become thoroughly familiar with the action of the preparation employed. The following formula is here given for those preferring a paste.

℞—Arseni trioxidi,	ʒj (4.0 gm.)
Cocainæ,	gr. x (0.6 gm.)
Thymolis,	gr. v (0.3 gm.)
Petrolati,	gr. x (0 6 gm)—M.
Fiat Unguenta.	

Sig.—Apply a small amount to the dentin immediately over the pulp.

I wish to state here something about the pharmacy of this prescription, for if the preparation does not work satisfactorily, it has not been properly compounded. Arsenic trioxid is the base, cocain is a local anesthetic, and when applied to the pulp produces a condition of analgesia by which the irritating action of the arsenic trioxid is without effect, and thus prevents the tooth from aching while the pulp is being devitalized. With the alkaloidal cocain and thymol, together with this amount of petroleum, a nice paste can be made with the arsenic trioxid. The author prefers a fiber which is made from the same formula as above by thoroughly incorporating it in some fibrous

vehicle. The fiber may be colored so that it is of a different color from the ordinary cement, which is used to seal the preparation in the cavity.

Technic of Application.—In those cases of pulpitis where the tooth has ached before the patient presents for treatment, it is always the best practice to allay the pain for at least twenty-four hours before attempting to devitalize the pulp. If for any reason this cannot be done conveniently and it is deemed best to make the arsenical application at this sitting, the engorged capillaries may be relieved by administering two or three doses of nitroglycerin, having about one hour intervening between each dose. This will also tend to mitigate the pain which sometimes accompanies the devitalization of the pulp. In any case, whether the tooth has ached or not, before applying the arsenical preparation or before adjusting the rubber dam, it is best to break down all overhanging edges of enamel and carefully remove or wash out with a nonirritating antiseptic solution any food-stuffs or débris which may be in the cavity. Food-stuffs contain albumin, and if such is in the cavity of the tooth when the arsenical preparation is applied, the arsenic trioxid will act upon the albumin, forming arsenic albuminate, and thereby a certain amount of the agent is neutralized or becomes inert. As much of the carious dentin should also be removed as can be done without producing pain, for the application should be made *to a sensitive spot in the cavity.* It is never necessary to have an exposure of the pulp; and in case an exposure exists, it is just as well to apply the preparation to the dentin immediately over the pulp, rather than to the organ itself, though in using the fiber suggested here there is no logical reason why it should not be applied directly to the exposed pulp. In any event the preparation should be covered with cotton or small metallic or paper disk to prevent pressure and also to prevent the phosphoric acid of the cement from coming in contact with the ingredients of the preparation.

Length of Time Application Should Remain.—There are at least four factors which govern the length of time an arsenical application should remain sealed within a tooth, viz.:

1. The age and general condition of the patient.
2. The general condition of the pulp itself.
3. The amount and condition of the dentin intervening between the pulp proper and the application of the preparation.
4. The climate or season of the year, strange as it may seem, influences the action of arsenic trioxid.

Taking into consideration these various factors, the arsenical prep-

aration should remain in the cavity from two to six days. At the second sitting the rubber dam should be adjusted, the teeth included sterilized, and the cement and preparation removed, after which every surface of the cavity should be freshened with a large round bur. This not only insures the thorough removal of the arsenical preparation, which, should a portion remain, is liable to produce pericemental inflammation, but it also *mechanically* sterilizes the cavity by removing the carious and infected dentin. This is important and is an aid in *maintaining asepsis* in the removal of the pulp. In the author's judgment, this is much better practice than to depend upon a solution of dialysed iron to neutralize the arsenic trioxid.

Opening Pulp Chamber and Exposing Canals.—The pulp chamber can now be opened into, observing practically the same details in removing the tissue and after-treatment as explained under the anesthetization method. Oftentimes, in the initial opening into the pulp chamber, and sometimes on entering the canal, after the application of arsenic trioxid, the patient will experience some pain; but by gently working the broach up the side of the root, very little, if any, pain need be produced in removing the pulp, provided, of course, the tissue is devitalized. However, should pain be experienced, it is best to seal formocresol or phenol compound in the cavity in contact with the tissue from one week to ten days, when it can be removed without pain. This is the method generally followed by the author whether the tissue is still sensitive or not at the time the arsenical preparation is removed.

Objections to the use of Dialysed Iron and Tannic Acid.—In connection with the *preservation of the color of the tooth*, under the anesthetization method the author stated his objection to the use of hydrogen dioxid for removing the blood from the cavity and canal. It is necessary here, also, to refer briefly to a well-established practice of treating teeth after the pulps have been devitalized. It is the practice of many dentists, after removing the arsenical dressing, to flood the cavity with a solution of dialysed iron, after which the pulp chamber is opened into, usually producing some hemorrhage; then, without any especial effort being made to remove the dialysed iron or blood, tannic acid in some form is sealed in contact with the pulp for a week or ten days, thinking it advantageous by this means to constringe and toughen the tissue before attempting its removal. Let us consider the rationalism of such treatment. The pulp tissue in all large canals is sufficiently tough to be removed in its entirety, and it must be disorganized or removed piecemeal in small canals, whether it has been pre-

viously constringed or not. Hence, there is no advantage in using tannic acid, and there is a serious objection. If those who follow this practice are observing, they will notice that after removing the tannic acid dressing, the pulp tissue is dark in appearance. They will also observe that many teeth thus treated subsequently discolor. The cause for this is found in the fact that tannic acid and iron, in any form, are chemically incompatible, the resulting compound being *iron tannate,* one of the most insoluble substances known to chemistry. In the presence of moisture a form of ink is produced which is a great staining agent for dentin, and one that is almost impossible to remove by any known process of bleaching.

As has been stated elsewhere, there are cases where, for want of time or other reasons, the pulp can be removed to advantage by devitalization; however, when this method is followed tannic acid should *not* be used, and every trace of dialysed iron (if used at all, and it is unnecessary to use it) and blood should be removed with alcohol or water.

When to Fill Canals.—In those cases where we are certain that the pulp is all removed and where the canals can be thoroughly dried, the root filling can be inserted at the same sitting, providing there are no symptoms of pericementitis in the apical area. There are many good reasons, however, for not filling the root at this time, some of which have been considered under the anesthetization method. Where the method has been followed of delaying the removal of the devitalized tissue until it has become thoroughly impregnated with the formaldehyd in the formocresol or the thymol in the phenol compound the canals can be filled at the time the tissue is removed. As previously stated, the author prefers this method.

COMPLICATIONS.—In our discussion thus far of the methods of removing pulps from teeth, we have considered only favorable cases, selecting the method best adapted to the case at hand. There are many instances, however, where it is difficult to remove the pulp by either the anesthetization or devitalization method, at least until the tooth is placed in a more favorable condition.

Hypertrophied Gum Tissue.—Oftentimes in approximating cavities the decay in one or both teeth has extended far beneath the gum, the rough gingival margin of the cavity acting as a slight irritant by which the gum tissue is stimulated, causing it to proliferate until it fills a portion of, and in some instances the entire, cavity. In such cases the first consideration is to dispose of the hypertrophied tissue. Where the gum fills only a portion of the cavity and the pulp of the tooth is not causing trouble, the cavity should first be en-

larged and washed with a warm antiseptic solution, after which it should be dried as well as possible and packed with warm gutta-percha. But in those cases where the gum tissue occupies the entire cavity, and especially where the tooth is aching, it should be removed at once. Hypertrophied gum tissue is quite tough and fibrous, and if it is elevated or pushed back by means of a flat instrument, it will usually be found that the attachment at the gingival margin is small and can easily be severed by employing gum scissors or a lancet, previously dipped in phenol. It is best not to tell the patient what you are going to do, for scarcely any pain will be experienced. The hemorrhage in these cases is usually profuse, but can readily be stopped by cauterization with 95 per cent. phenol or a 50 per cent. solution of phenolsulphonic acid. The blood should now be thoroughly removed, the cavity dried, moistened with eucalyptol, and packed with gutta-percha, letting it extend buccally and lingually to fill the interproximal space. The gutta-percha can be removed from the interior of the cavity with a heated flat instrument. Quite often the most practical way of adjusting the rubber dam in these cases is to place the clamp on the tooth posterior to the one thus packed, having a single hole in the dam include both teeth. The packing, if properly placed, will prevent leakage. The pulp can now be removed by the method which the operator deems the most feasible.

Importance of a Correct Diagnosis as to the Kind of Tissue in Cavity.—There is one instance in the removal of pulps from teeth where students particularly are liable to make a serious mistake if they are not extremely careful. That is, in cases where, in large occlusal cavities, especially in lower first molars of children, the pulp has died and the decay has extended through the bifurcation of the roots, leaving rough edges which continually irritate the tissue, causing it to proliferate and ultimately fill the cavity. To carelessly force the anesthetizing solution into such a cavity, where the pulp in the canals is putrescent, would be the means of causing an acute alveolar abscess. The application of arsenic trioxid would mean the loss of at least one tooth, perhaps one or two on either side of the one to which the application was made, with a portion of the alveolar process.

Before applying either the anesthetizing or devitalizing agent, a correct diagnosis should be made; we should ascertain definitely the kind of tissue in the cavity. With a little experience this is usually a simple matter. The history of the case as related by the patient will often serve as a guide. Pulp tissue is generally more sensitive than gum tissue, and when slightly pricked with a sharp instrument bleeds

more profusely. If the tissue proves to be hypertrophied gum tissue it can be disposed of in the usual manner, the puncture closed temporarily with cement or gutta-percha and the tooth treated as the condition necessitates (see Figs. 3 and 4, page 280). When this cannot be accomplished, it is necessary to extract the tooth.

Hypertrophied Pulp Tissue.—In cases where the tissue is hypertrophied pulp tissue, it will generally be found unusually resistant to both cocain hydrochlorid and arsenic trioxid, and it is sometimes necessary to resort to actual cautery by employing strong escharotics or to the administration of such general anesthetics as nitrous oxid in order to painlessly remove the tissue.

Secondary Dentin, Pulp Nodules, and Pulp Calcification.—Quite frequently we find cases where it seems almost impossible to force the anesthetizing solution through the dentin and into the pulp, and when arsenic troxid is applied it has little or no effect. In

FIG. 5.—In this case the author desired to insert a bridge. On opening into the third molar and second bicuspid, which teeth where to be used for the abutments, we were unable to find any canals in the bicuspid and only a small canal in the molar. The skiagraph confirms the clinical findings.

these cases we can suspect that the pulp has receded because of some slight but continued external irritation and the space filled in with secondary dentin, the tubuli of which are irregular and do not run at right angles to the base upon which they rest, as in the normal dentin. Occasionally cases will present where the entire canal has been obliterated (see Fig. 5). This condition is more often found in elderly patients. As a result also of external irritation, pulp nodules and pulp calcification are sometimes encountered. Many times in removing the pulp in these cases, the most painless and best results are obtained only by a combination of both the anesthetization and devitalization methods; for the removal of these pulp nodules and

calcified pulps is often a difficult procedure. After we have used cocain hydrochlorid and pressure or previously applied arsenic trioxid and anesthetized or devitalized a portion of the pulp, we may be able to reach the pulp nodule or nodules without producing pain. But frequently these calcific bodies are agglutinated, and close the mouth of the canal; especially is this condition found in the molar teeth. The pulp tissue immediately under the nodule is extremely sensitive. In such a case the anesthetizing solution could not be forced into the canal without first removing the obstruction, and arsenic trioxid, if applied, would have no effect. These are cases which require much perseverance and patience on the part of both patient and operator. The nodule can sometimes be loosened by gently working around it with an exploring or other suitable instrument. The author has met with success by taking a small round bur and drilling past the nodule, care being taken not to puncture the root, then with the engine running rapidly the nodule is tapped and dislodged. When the obstruction in the pulp chamber and canals is removed the remaining tissue can be anesthetized or devitalized in the usual manner. If the devitalization method is employed, the arsenical preparation can be placed over the mouth of the canal with safety; but it is never advisable to place the preparation down in the canal. In extreme cases it may be necessary to inject local anesthetics into the gum and pericemental membrane, and thus anesthetize the pulps, or nitrous oxid and oxygen may be administered.

REMOVAL OF PULPS FROM DECIDUOUS TEETH.

There is perhaps no dentist who has been in practice for any length of time but who has been called upon to remove an exposed pulp from a deciduous tooth. With the so-called "horrors of the dental chair" magnified in the child's mind, as is too generally the case, this is not often the most pleasant thing the dentist is called upon to do. The question resolves itself largely into the proper handling of the child. Any expedient may be employed to gain the confidence of the little patient, after which either the anesthetization or devitalization may be used as deemed best under the conditions. Generally the latter method is preferable; and it will be found that the pulps are peculiarly susceptible to the action of arsenic trioxid. The preparation should not be left in the tooth longer than from sixteen to twenty-four hours and then only a small amount should be employed. After the pulp is removed, all that is necessary to fill the root is to flood with eucapercha compound, and fill the entire cavity with

gutta-percha. It is supposed by some dentists that resorption of the roots does not take place when the pulp is destroyed. This supposition is wrong. The root may not be destroyed as readily as though the pulps were alive, but that resorption does take place has been clinically demonstrated in the author's practice. Hunt, of Indianapolis is of the

FIG. 6.—This skiagraph, taken by Ream, shows the resorption of the deciduous molar roots, due to the eruption of the permanent bicuspids. In this case the pulps of the deciduous molars were vital.

opinion that the process here involved is one of absorption rather than resorption, and that the loss of tooth-root is usually due to the advances of the permanent teeth (see Fig. 6).

ARSENICAL POISONING.

It may be well to re-consider here the treatment of *local poisoning by arsenic trioxid.* However, when such treatment is necessary, it is due to carelessness on the part of the dentist or the patient, or both. It is never necessary to tell the patient what drug or remedy has been used in the treatment of teeth, many times it is advisable not to do so; but whenever an agent as destructive as arsenic trioxid is sealed within a tooth, the patient should be thoroughly impressed with the importance of keeping an appointment, and of returning before the appointed time should any untoward symptoms develop. The patient should also be informed that the teeth thus treated might ache for a few hours, as they sometimes do, even when cocain is a constituent of the arsenical preparation; but that the aching will be of short duration. In case, however, the tooth or gum becomes sore, they should be instructed to return at once.

In those cases where the arsenical preparation is not hermetically sealed within the tooth and some of it gets on the gum tissue, remaining only long enough to cause devitatization, all that is necessary is to first wash the part with an antiseptic solution, and then mechanically pick off the dead or sloughed tissue with sterile pliers until bleeding is

produced, if this is possible, after which the part should be *disinfected* and the tissue *stimulated*. To disinfect the part, any good disinfectant can be used. Nothing is better here than the official 3 per cent. solution of hydrogen dioxid. As a means of stimulating the cells, iodin compounds are useful. The official compound solution of iodin (5 per cent.) can be applied by first drying the part. After removing the dead tissue and disinfecting, the author prefers applying the euroform paste on cotton or gauze. A prescription should also be written for an antiseptic mouth-wash with which the patient should keep the mouth as clean as possible. The treatment can be repeated as often as the case necessitates; usually one or two treatments will suffice.

In those severe cases where the arsenic trioxid has penetrated to, and devitalized the process as well as the gum, the first treatment is surgical. After washing with an antiseptic solution, the affected process should be removed with a suitable bur in the engine. It may be necessary in extensive cases to extract the tooth, after which the treatment is practically the same as has been outlined above. Sometimes there is pain following the surgical removal of the affected process. In this case the euroform paste is especially indicated; the orthoform controls the pain, the europhen disinfects and stimulates, and the liquid petroleum keeps the saliva, laden with bacteria, out of the wound. The case should be watched closely and the stimulating treatment kept up until the part has healed. The tissue in the interproximal space will never be fully reproduced, and will always be a source of more or less annoyance.

It will be noted that in discussing the treatment of local arsenical poisoning, no mention has been made of dialysed iron. The practice of applying this agent to the affected part is both useless and wrong.

In conclusion, the author desires to emphasize what was stated in the beginning, that it is the plain duty of every practitioner to save the pulps of teeth in all cases where it can be done with any reasonable degree of success; yet experience and observation will soon show the folly of attempting to save a pulp that is in the state of passive hyperemia or true inflammation, and will prove also that in these cases, the safest practice is to remove the pulp and subsequently fill the canals, notwithstanding the difficulty often attending the performance of this operation. It behooves us, therefore, to study carefully the pathology of the dental pulp, that we may be able to diagnose the condition correctly and apply our therapeutics accordingly.

NONSEPTIC PERICEMENTITIS.

GENERAL CONSIDERATIONS.

It is not the intention to introduce in these pages needless pathologic facts, yet in the treatment of pericementitis it is important to remember that the pericemental membrane is very vascular and well supplied with nerves; that it is enclosed within bony walls, and, therefore, when inflammation exists in the tissue the membrane becomes thickened, forcing the tooth from its socket. This elongation of the affected tooth is one of the chief symptoms of true pericementitis.

Before discussing the therapeutics of this condition, I desire to indelibly impress upon the mind of the reader the fact that this condition is too frequently produced by carelessness on the part of dentists. It is not always possible to successfully perform dental operations without irritating the susceptible pericemental membrane; however, much of the trouble can be avoided if judgment is exercised and proper precautions are taken in treating teeth.

It is important that we differentiate here between *nonseptic* and *septic pericementitis.* Both are inflammatory conditions of the pericemental membrane, the difference being due largely to the exciting agents causing the pathologic condition. Septic pericementitis is produced by pathogenic bacteria, poisonous ptomains, and irritating gases which have escaped from putrescent or septic root-canals, the therapeutics of which will be discussed later.

There are at least two classes of irritants by which nonseptic pericementitis is produced, viz.:

1. Drug irritants.
2. Mechanical irritants.

Drug Irritants.—There are many circumstances and conditions which influence the action of drugs upon different individuals and upon the same individual under different conditions. We find cases occasionally where pulps have been removed by pressure anesthesia, and where, seemingly at least, every precaution was taken in sterilizing the dentin, selecting a sterile anesthetizing solution, and in applying the pressure, yet severe apical pericementitis follows. This may or may not be due to the drugs used in performing the operation. There are cases, too, where the pericemental membrane becomes highly in-

flamed and extremely responsive from the action of arsenic trioxid, even when the drug was properly sealed within the tooth only a short time. These are conditions over which the operator seems to have no control; however, drugs are often used injudiciously. It has been stated elsewhere that an anodyne treatment was indicated after the mechanical or surgical removal of the pulp. Therefore, care should be taken to select drugs for this purpose which produce a soothing and not an irritating effect. There are some instances in dental practice where we desire to irritate and thereby stimulate the pericemental membrane; but this should be avoided here. Judgment should also be exercised in sealing in anodyne remedies, such as phenol, oil of cloves, etc., in the canals, especially in bicuspid and molar teeth, for should the temporary filling be left too full and the remedy forced through the apex by the closing of the jaws, even these agents cease to be anodynes and become irritants. Whether phenol, oil of cloves, and similar drugs or remedies are anodynes or irritants, depends largely, then, on where and how they are used.

In filling root-canals it is the practice of many dentists to moisten the canals with *eucalyptol* before introducing chloropercha and the gutta-percha cone. Care must be taken here to use eucalyptol and not oil of eucalyptus, unless it be the refined product. Commercial oil of eucalyptus has been the cause of many cases of apical pericementitis following the most careful filling of root-canals. The eucalyptus tree produces a volatile oil which contains three constituents, each distilling over at different temperatures; the first product thus obtained is eucalyptol, hence the most volatile constituent of oil of eucalyptus and the one which is the solvent for gutta-percha. While eucalyptol is a slight irritant, it is not nearly so irritating as oil of eucalyptus. The irritating property of eucalyptol can be modified and its antiseptic value increased by adding menthol and thymol in the following proportion:

℞—Mentholis,	gr. ij (0.13 gm.)
Thymolis,	gr. iij (0.18 gm.)
Eucalyptolis,	f℥j (4.0 c.c.)—M.

Sig.—Use as directed.

This remedy is equally as good a solvent for gutta-percha as is eucalyptol alone, and will be called *eucalyptol compound* in the following pages.

Some drugs when internally administered, notably mercury and its compounds, are capable of producing nonseptic pericementitis. This has been previously mentioned under Mercurial Stomatitis.

Mechanical Irritants.—The pericemental membrane is frequently, I might add too frequently, irritated by mechanical irritants,

such as root-canal fillings, ill-fitting partial plates, crowns, and bridges, malleting, regulating, faulty occlusion, salivary and serumal calculus, etc. There is perhaps more pericementitis produced by root-canal fillings than by any other mechanical irritant. In filling root-canals we should be absolutely certain that the canal is *aseptic*. If there be any doubt as to this, the operation should be deferred. The technic of filling root-canals will be discussed later; however, it is well to mention here that care should be taken in filling all large canals so that the filling material may not be forced through the apex of the root; especially should we be careful in filling the canals of teeth after having treated an alveolar abscess. In these cases we must not expect the patient to flinch in filling the root, for there is no live tissue at the immediate end. The apex has been enlarged and it is very easy to force the filling material through into the space where the tissue has been destroyed. When granulation fills this space and the newly formed tissue comes in contact with the foreign material the result is likely to be a "lame tooth," which means pericemental trouble (see Fig. 10, p. 318).

THERAPEUTICS.

The first step in the treatment of nonseptic pericementitis is to adopt the surgical principle of ascertaining the cause and removing or correcting it, if at all possible. In the earlier stages of pericemental inflammation, it is not always an easy matter to ascertain the *true cause* of the disturbance. For instance, in those cases following the removal of the pulp tissue, it is difficult to know whether the cause is the root filling, the medicine used in the treatment, or whether we failed to establish and maintain asepsis in performing the operation. The author is inclined to believe that it is more frequently the latter than most operators are willing to admit; for certain it is that the more nearly we approach *absolute asepsis* in these operations, the less pericemental trouble we will have. The teeth thus affected are extremely sore, and any remedy can be used in the treatment that will give immediate relief. This is what the patient most desires, and, too often it appears, it is that which the dentist fails to give. Both local and general remedies can be employed. General remedies are more valuable in the treatment of septic pericementitis. If they are used at all in treating nonseptic pericementitis, they should be used only in cases where the patient is nervous and has lost considerable sleep, unless some drug, like nitroglycerin, is given to relieve the engorged capillaries. For immediate relief we must depend largely upon the local application of drugs and remedies. In those cases following the removal of the pulp

by either the anesthetization or devitalization method, and where the canals have not been filled, the pain can be relieved almost instantly by the following method: Adjust the rubber dam. If it is necessary to use a clamp, it should be placed on the tooth posterior to the one affected. Sterilize the teeth included in the dam and remove the dressing from the canals. Dehydrate the tooth-structure with absolute alcohol. Then wrap cotton loosely around a smooth, sterile broach, dip in oil of cloves or eugenol, and carefully work in each canal. Remove the broach, leaving the cotton. Heat should now be applied to the remedy by means of a hot-air instrument or a chip-blower until the cotton becomes dry. Repeat this process several times, after which the same remedy should be carefully sealed within the canal. Under no condition should the cavity be left unsealed. In the above treatment, we not only get the benefit of the heat, which is valuable, but the eugenol, the constituent of cloves, is driven into the tooth structure, producing a profound anodyne effect upon the sensitive membrane. The author has succeeded in giving immediate relief by this method of treatment when many others have failed. Grinding the cusps of the tooth where it can be done without injury is advisable; a counterirritant can be applied to the gum and the patient dismissed for several days. It is well also to prescribe two or three doses of nitroglycerin to facilitate the circulation of blood in the membrane. It is scarcely necessary to instruct the patient to favor the tooth.

In the treatment of pericementitis following the filling of the root, having every reason for believing that the canals were aseptic, one of the last things the author would suggest doing would be to attempt to remove the root filling. Usually this only serves to further aggravate the condition. These cases can best be treated by counterirritation and general remedies. By counterirritation is meant the application of an irritant to some normal part of the body for the purpose of influencing favorably some other part, usually deep-seated, which is diseased. This irritant is generally applied to the gum over the affected tooth. Capsicum plasters, black mustard papers, cantharidal collodion, all official preparations, are valuable; or the following liniments, which are more generally used, give much relief:

℞—Mentholis,		gr. xx (1.3 gm.)
Chloroformi,		f℥j ss (6.0 c.c.)
Tincturæ aconiti,	q. s. ad.	f℥j (30.0 c.c.)—M.

Sig.—Dry the gum and apply freely over the affected tooth, keeping the field dry for a few seconds.

This preparation is known as *dental liniment.*

℞—Mentholis,
Iodi (crys.), āā gr. x (0.6 gm.)
Chloroformi, f℥jss (6.0 c.c.)
Tincturæ aconiti, q. s. ad.. f℥j (30.0 c.c.)—M.
Sig.—Make one application to the dry gum as above.

This liniment is called *refrigerant counterirritant.*

℞—Liquoris iodi compositæ, f℥j (30.0 c.c.).
Sig.—Use as above.

This is the official compound solution of iodin, known also as Lugol's solution.

Inasmuch as tincture of aconite is an important ingredient in many liniments used in the local treatment of pericementitis and facial neuralgia, it is well to remember that the United States Pharmacopeia of 1900 reduced the strength of this preparation from 35 per cent. to 10 per cent. Therefore the new tincture can be employed more freely in these cases without danger of poisoning.

As a remedy to be applied by the patient at home, a split raisin, soaked in hot water, and on which is dusted red pepper, can be held on the gum over the affected tooth. A very efficacious remedy is to direct hot water with some force on the part, beginning with warm water and increasing the heat gradually until it is nearly boiling. This must be kept up until we get the full benefit of the heat and resolution promoted. Another good remedy to have the patient employ, is the hot foot-bath. The value of this remedy, like the application of hot water to the gums, depends largely upon the manner in which it is done. A deep foot-bath tub should be used and the temperature of the water gradually increased until it is as hot as can be borne. This should be continued from twenty to thirty minutes.

There are many other drugs and remedies which can be employed in the local treatment of this condition. Those which have been mentioned here the author has found valuable in his practice. It is far better to have a practical knowledge of a few remedies than a superficial knowledge of many. The general remedies to be administered in the treatment of nonseptic pericementitis, if found necessary, will be discussed subsequently under the treatment of septic pericementitis and incipient abscess, which conditions are closely related.

PUTRESCENT PULPS.

GENERAL CONSIDERATIONS.

The treatment of putrescent pulps and their sequelæ in the past has, to a great extent, been purely empirical. The reason for this can be found in the apparent lack of interest which generally has been shown in the chemistry of pulp decomposition. A knowledge of the changes wrought in the splitting up of the complex bodies of the dental pulp by microorganisms is of vital interest to every practising dentist; and every student should therefore familiarize himself with this important subject.[1] The only method by which drugs and remedies can be scientifically applied to the treatment of the condition under consideration is to have a definite knowledge of the intermediate and end-products resulting from the putrefactive process.

Every practitioner of dentistry knew from sad past experience that in the process of pulp decomposition some kind of mephitic gases were evolved which, if confined, would produce severe pathologic disturbances; but just what the gases were and how the unfavorable conditions were brought about we were left to conjecture. From our study of the chemistry of pulp decomposition we have every reason for believing that the main gases produced are *ammonia* and *hydrogen sulphid*. When these gases are generated and cannot readily escape through a cavity, pressure is produced, thereby forcing the infectious material through the apices of the roots into the surrounding tissue, from which infection, septic pericementitis, and in many instances an alveolar abscess result.

Coagulating Drugs.—There has been much discussion in the dental literature of the past in regard to the penetrating or non-penetrating power of coagulating agents in putrescent root-canals. It is true, as claimed by some authorities, that such drugs as phenol, creosote, solutions of zinc chlorid, etc., are contraindicated in the treatment of putrescent pulps, but not because they possess the coagulating property; for when the dental pulp is undergoing or has undergone the process of decomposition, the proteid constituents or coagulable substances have lost their former identity, and new com-

[1] The chemistry of pulp decomposition has been discussed by the author in Johnson's "Text-book of Operative Dentistry," p. 341; and in various dental journals.

pounds with entirely different properties have been formed. In selecting drugs to be used in the treatment of this condition, the author will therefore eliminate the question of coagulation, and will select drugs, which if properly used, will unite chemically with the intermediate and end-products of decomposition, converting them into odorless and non-infectious compounds, as well as destroy germ life.

Important Products of Pulp Decomposition.—In this connection it should be remembered that the putrescent condition has been brought about through the agency of microorganisms by a gradual analytic process, and among the products formed which must be considered in the treatment are *hydrogen sulphid, poisonous ptomains* and *ammonia* or derivatives, the latter gas being evolved from the further putrefaction of the intermediate compounds (ptomains and amido acids). It is well to remember also that *fats* or fatty acids are a class of end-products resulting from the putrefaction of proteid substances.

The main gases formed, then, are ammonia and hydrogen sulphid. Now it will be necessary to dispose of these gases in order to hermetically seal the cavity, an object the accomplishment of which is much desired in the treatment of these cases; for by so doing we prevent the oral fluids from contaminating the medicine within the tooth, the medicine from escaping into the patient's mouth, and the tooth from changing color during the time of treatment.

Drugs Indicated.—It has been shown by Cassidy and others that *formaldehyd* (CH_2O) is a valuable therapeutic agent if properly used. This gas occurs in commerce in a 37 per cent. aqueous solution, which solution is recognized by the United States Pharmacopeia of 1900 under the name of liquor formaldehyd, or formalin. The gas will unite with ammonia, producing urotropin, a solid, as $6CH_2O + 4NH_3 = (CH_2)_6N_4 + 6H_2O$.

Formaldehyd unites also with hydrogen sulphid, forming, in the author's opinion, methyl alcohol, a liquid, and sulphur, a solid, as $2CH_2O + 2H_2S = 2CH_3OH + S_2$.

It is stated on good authority that this same gas, formaldehyd, unites with basic ptomains, forming inodorous compounds. By the use of formaldehyd, then, the *irritating gases* and *poisonous liquids* (largely ptomains) can be changed chemically into *nonirritating* and *nonpoisonous liquids* and *solids*. The official solution of formaldehyd, however, is too irritating for general use; therefore, inasmuch as fats result from pulp decomposition and are present as such in a putrescent root-canal, the author selected *cresol* as an agent with which to dilute

the official solution and thereby modify the irritating action of formaldehyd. Cresol is now also recognized by the United States Pharmacopeia of 1900 under this name. Formerly the product was commercially called *tricresol.* This agent has a tendency to darken when exposed to light. It is recommended that a clear solution be obtained and then kept in an amber-colored bottle.

Liquor formaldehyd can be diluted with such other agents as phenol, or creosote, if, in the latter instance, a small amount of alcohol is added to clear the solution. Cresol, however, is recommended for four principal reasons:

1. It is miscible with the liquor formaldehyd in all proportions, thus making, without the addition of alcohol, a good pharmacal product from which formaldehyd gas is constantly generated.

2. It is a good disinfectant, much more powerful than phenol.

3. It possesses an anodyne property which modifies the irritating action of formaldehyd.

4. It acts chemically upon the fatty compounds, thereby disposing to advantage of these substances.

Factors to be Considered.—In the successful treatment of the conditions under consideration, there are three important factors which must be accomplished:

1. Establish asepsis.
2. Prevent recurring sepsis.
3. Preserve or restore the color of the tooth.

THERAPEUTICS.

In calling the attention of the reader to a method of treating this condition, which has proved very successful in the author's practice, I desire to emphasize the necessity for observing the details of the method.

First Sitting.—Our first duty in these cases where we suspect that the pulp is dead, after washing or spraying the patient's mouth with a warm antiseptic solution, as should be done in all treatment cases, is to adjust the rubber dam in every case where it is possible to do so, and sterilize all of the teeth included therein. For this purpose either a 10 per cent. solution of formaldehyd, to which a small amount of borax has been added, or a 1–500 solution of mercury bichlorid in cinnamon water, or a 1–200 sublamin solution can be used. After using one of these solutions the teeth are bathed in alcohol and dried with a current of air. If the dam cannot be adjusted, the tooth should first be treated

as explained on the next page, under Badly Decayed Root. Now we are ready to confirm our diagnosis. With a suitable round bur, the pulp chamber is freely opened. It is not enough here to simply determine whether the pulp is dead or alive; but, if dead, an effort should be made to determine whether the condition is one of true putrescence with the characteristic odoriferous and gaseous end-products or whether, as sometimes occurs, the active pyogenic microorganisms have liquefied a part or all of the bulbous portion of the pulp, forming drops of pus in the pulp chamber with practically no odor, and with the tissue in the canals still vital.

With the method of treatment under consideration, the same remedy is indicated in either case, but the amount used varies according to the condition as found.

If the case is one of true putrescence the mouth of each canal should be exposed, but no effort should be made to remove the contents therein at this sitting. A pledget of cotton, loosely rolled and of sufficient size to fill the pulp chamber, should now be thoroughly saturated with the following remedy and placed in the chamber over the mouth of the canal:

℞—Cresolis,
Liquoris formaldehydi, āā f℥j (4.0 c.c.).—M.
Sig.—Use as directed.

For convenience this remedy will be called *formocresol.* It is always best to seal the cavity with a quick-setting cement, for the remedy should be *hermetically sealed and pressure must be avoided.* So-called temporary cements are now on the market, and they are filling a long-felt want. To prevent the cement from filling the entire cavity and also to facilitate its subsequent removal, metallic or paper disks or even cotton can be placed over the remedy, filling most of the cavity, when only a veneer of cement is necessary to hermetically seal it. This dressing can remain until you wish to have the patient return for a subsequent sitting. The author prefers to leave it about two or three days. However, it can be safely changed the following day, and no harm follow if it remains a week or more.

Second Sitting.—At the second sitting, the rubber dam should be adjusted, the teeth included sterilized, and the dressing removed, after which the canals should be mechanically cleaned with a proper broach, exercising the same judgment here in the selection of the broach as has been elsewhere emphasized. If there be any odor in the canals characteristic of putrescence, or if effervescence is produced

by testing with a solution of hydrogen dioxid, the canals should be dehydrated with alcohol and warm air as thoroughly as possible, and formocresol again placed on cotton, this time loosely in each canal, and the cavity hermetically sealed.

In those cases, where, at the second sitting, there is no evidence of putrescence, which will be found to be the condition generally if the first treatment properly employed, a smaller amount of formocresol should be used. It is not necessary to modify the original formula as formerly suggested. This dressing should remain for at least three days, by which time the remedy will have sterilized the entire tubular structure of the dentin, thus *establishing asepsis.* All that is necessary now to *prevent recurring sepsis* is to thoroughly fill the canals. This remedy will not discolor tooth structure, and the fact that it not only can but should be *hermetically sealed in the cavity* will prevent discoloration by the ingress of the fluids of the mouth. In case the color of the tooth crown was lost before undertaking the treatment and being desirous of preserving the tooth by an inlay or filling, the *color can be restored* by one or two applications of sodium dioxid or caustic pyrozone. The use of these agents will be explained subsequently under Bleaching Teeth.

COMPLICATIONS.—Occasionally we encounter some complication in the treatment of putrescent pulps. These will now be considered.

Badly Decayed Root.—Formocresol is very destructive to the soft tissues of the mouth, therefore the importance of always adjusting the rubber dam. If this cannot be done on account of a badly decayed root, it is suggested that care be taken in sealing the remedy in the cavity at the first sitting, and, in placing the cement, the original outline of the root can be approximated. After the cement has set, a band or matrix of gold or German silver can be fitted to, and cemented to the root. In doing this it is best to use a cement of different color from that employed for treatment purposes; and in treating the case where there is a tooth posterior, it is best to place a clamp on this tooth and gently stretch the rubber over the band and thereby avoid loosening it.

Pulp Partially Alive.—In those cases where the pulp tissue is putrescent in one or more canals of a multirooted tooth and alive in the other one or two canals, as the case may be, we will find much satisfaction in using the formocresol remedy. These are exceptional cases and it is difficult to know whether this condition exists until the second sitting. If there be much vitality in the live pulp tissue, the

formaldehyd in the remedy will doubtless make the tooth ache, but after we know the conditions our method of procedure is simple, and the results will be certain. A small pledget of cotton dipped in the remedy can gently be placed over the mouths of the canals which contain putrescent material, and a thin quick-setting cement flowed over the cotton. After the cement has set, the live pulp tissue in the remaining canals can be anesthetized or devitalized as the operator deems best at the time. Formerly these were difficult cases to treat, but with a remedy which can be hermetically sealed in a putrescent root-canal, the procedure is materially simplified.

It was previously mentioned that one may occasionally open into a suspected tooth, having all the symptoms of a dead pulp, and find a drop of pus in the bulbous portion of the pulp with the remaining portion still alive. Some writers call this condition a *septic* pulp in contradistinction to *true putrescence* (presence of gases). In such a case, any remedy containing formaldehyd may cause the tooth to ache; therefore, this must be taken into consideration, and in the treatment of so-called septic pulps, the pus should be washed out of the cavity with a warm antiseptic solution, the cavity dried, and asepsis established by hermetically sealing in a much smaller amount of formocresol than that generally used in cases of true putrescence. If this precaution is taken the tooth will not ache long, even in cases where no odor is present and the vital tissue is still quite sensitive. This remedy will sterilize the tissue, after which, at the second sitting, the pulp can be anesthetized or devitalized as usual.

Pulp Dead and Desiccated.—Sometimes on opening into a dead pulp we find the canal dry and odorless. This condition is called *dry gangrene* of the pulp. It is not really a complication if we recognize that microorganisms may be present and seal a disinfectant in the canal for at least twenty-four hours. One treatment of formocresol or phenol compound will correct any possible trouble, when the canal can be filled.

The author realizes that the method of treating putrescent pulps, here given, is a radical departure from those generally advocated; and, like myself at first, some of my experienced readers may hesitate to hermetically seal a cavity in a tooth which contains a putrescent pulp. The reason this could not be done in the past by the methods in vogue is, that drugs, in most instances, were selected and used solely because of their ability to inhibit the growth or destroy the vitality of microorganisms. The fact that there were other things, such as irritating gases and poisonous ptomains, found in the canal and tubular

structure of the dentin, and also the further fact that it was as necessary to dispose of these substances as it was to destroy germ life, however essential and important this is, was not given the significance this phase of the subject merited. The treatment which is here outlined is along rational lines, for the remedy chemically converts the noxious intermediate and end-products of pulp decomposition into substances which themselves possess antiseptic and disinfectant properties.

OTHER METHODS.—A method of treating putrescent pulps by the use of metallic potassium and sodium was given to the profession by Schreier, of Vienna, in 1893. It consists in chemically neutralizing the intermediate and end-products of pulp decomposition, and at the same time establishing asepsis by using a mixture of the metals. The preparation may be obtained in a small tube, covered with paraffin, which prevents undue exposure to air and moisture. The method is favored by Rhein and others, and its technic follows: With the rubber dam adjusted and every thing in readiness, a barbed broach may be pushed through the paraffin covering and into the metallic mass, and by gently withdrawing small particles adhere, in which manner it may be transferred to the putrescent canal. A violent reaction at once takes place, the metals attack the water molecule, and hydroxids are formed, which in turn act upon the fatty end-products, forming a soluble soap which can subsequently be washed out of the canal, leaving it clean and sterile. If care is exercised in the technic, the entire contents of the canal may be chemically destroyed, when the latter may be dehydrated with alcohol, an anodyne remedy sealed in, and, at a subsequent sitting, the case giving a favorable history, the canals can be filled.

Kirk, Hodgens, and others recommend sodium dioxid for the same purpose, and the agent is used in practically the same manner. The chemistry involved in the treatment is similar to that of Schreier's method, except, besides having sodium hydroxid formed which acts upon the fatty end-products, oxygen in the nascent state is liberated, which aids in establishing asepsis and at the same time tends to bleach the tooth.

Some years ago Callahan, of Cincinnati, introduced a method of treating putrescent pulps by destroying the contents of the canals with a 50 per cent. solution of sulphuric acid. The agent is gently worked into each canal and the contents thereby is chemically acted upon in such a manner as to bring about sterilization. When this is accomplished, the excess of acid may be neutralized with a 10 per cent. solution of sodium bicarbonate, the canals desiccated and an anodyne

remedy sealed therein. The crown of the tooth may be protected by a coating of paraffin. The method has the one distinct advantage of enlarging the canals at the same time asepsis is being established. These methods of treatment should not be used by careless operators. The danger lies in forcing the putrescent material or remedy through the apices of the roots, which always results in an extremely sore-tooth, if not an alveolar abscess.

The methods are discussed here briefly because they are chemically correct and are along rational and scientific lines. If care and judgment is exercised in the use of the remedies mentioned, good results will surely follow.

SEPTIC PERICEMENTITIS AND ACUTE ALVEOLAR ABSCESS.

GENERAL CONSIDERATIONS.

The treatment of septic pericementitis and acute alveolar abscess, as was intimated under Nonseptic Pericementitis, is so nearly identical that the therapeutics will be discussed here conjointly. In those cases of putrescent pulps where the patient did not present for treatment until the confined gases had escaped through the end of the root, carrying the bacteria and poisonous ptomains into the surrounding tissue, it is our duty to try to aid Nature in aborting an abscess. It is in these cases that good judgment must be exercised and extreme care taken. There is no condition which we are called upon to treat wherein a practical knowledge of pathology and therapeutics will serve us better than in this particular case. Frequently patients delay coming to the dentist until the infection has progressed to a point where all remedies will fail in aborting an abscess; but in many instances *this result* may be prevented by the proper use of drugs.

THERAPEUTICS.

Local Treatment.—The local treatment here is exactly the same as for an ordinary putrescent pulp; for you never have a case of septic pericementitis or incipient alveolar abscess unless the pulp is dead and has undergone, partially at least, the process of decomposition. However, if the tooth is extremely sore, as is usually the case, the patient need not be subjected at this sitting to the annoyance of adjusting the rubber dam. Keep the tooth just as dry as possible, open into the pulp chamber, holding the tooth by some means, while drilling, so that the jarring will not further irritate the condition; then carefully seal in the formocresol remedy with cement; after which our attention, if necessary, should be given to the treatment of the infected pericemental membrane.

General Treatment.—In order to control the infection, and at the same time aid Nature in readjusting the abnormal condition, it is not only our privilege, but it is our duty in these severe cases to administer internal drugs. Here alterative drugs are indicated. The

great representative of the alterative class is potassium iodid, which can be given in the following prescription:

> ℞—Potassii iodidi, ℨjss (6.0 gm.)
> Syrupi sarsaparillæ comp., f℥iij (90.0 c.c.).—M.
> Sig.—Take a teaspoonful in water after meals.

Ordinarily, the directions would be as given, to have the patient take a teaspoonful three times a day after meals; but in these cases of septic pericementitis or incipient alveolar abscess it is best to direct the patient to take a teaspoonful every two hours until three or four doses are taken, and then follow the directions written on the label. It is well also to avoid the accumulation of blood in the part. To prevent this, saline cathartics are indicated—one that can be given is the official solution of magnesium citrate, owing to the facility with which it can be taken and its acceptability to the stomach, a prescription for which follows:

> ℞—Liquoris magnesii citratis, f℥xij (360.0 c.c.).
> Sig.—Take one-half at once and the other half in two (2) hours, if necessary.

Magnesium sulphate (Epsom salts) is also an excellent remedy to be used for the latter purpose. The patient can be directed to take a teaspoonful dissolved in a wineglassful of warm water, having a glass of cold drinking water at hand to drink at once after taking the strong hyperisotonic salt solution. The cold water removes at once the bitter and unpleasant taste of the salt. A very good remedy to have the patient employ at home is the hot foot-bath. Unless some condition exists which would contraindicate, it is always good practice to administer nitroglycerin to deplete the capillaries in the affected, and in these cases *infected* tissues.

As stated on page 192, echafolta is a purified, assayed form of echinacea—a drug which is used extensively by eclectic medical practitioners. The author is able at this time to report favorably on the use of echafolta in all cases of infection. The dose here is from 5–30 min. (0.3–2.0 c.c.) given in water every two hours, until the acute symptoms subside.

In malarial regions and in the spring of the year in many localities the salts of quinin can be given, with beneficial results. The salt which the author prefers giving, if indicated in the conditions under consideration, is quinin bisulphate. Nearly all pharmacies have the salts of quinin bisulphate put up in the form of pills. While these pills may be given, it is much better to write a prescription for capsules. The

gelatin capsule is soon dissolved in the stomach; thus we obtain the action of the drug more rapidly than when given in the dry, hard, pilular form. The following prescription can be written for the drug in two-grain doses:

℞—Quininæ bisulphatis, gr. xxiv (1.5 gm.).
Ft. capsula, No. xij.
Sig.—Take one capsule every hour until the effect becomes noticeable.

Quinin acts differently upon different individuals. Most adult patients know the effect of this drug upon their system, and therefore will be able to aid the dentist in determining the amount to be taken in a given case.

One of the most prominent symptoms with which we have to content here is pain. In most cases the pain will subside soon after the local treatment; however, it is necessary occasionally, where the patient is nervous and has lost considerable sleep, to administer drugs which act upon the central nervous system, thereby controlling the pain. There are several drugs which, if properly given, will produce the desired effect. The official compound powder of acetanilid s here recommended and can be prescribed as follows:

℞—Pulveris acetanilidi comp., gr. xij (0.8 gm.).
Ft. chartula, No. ij.
Sig.—Take one powder at once and the other in two (2) hours, if not relieved.

Another very useful prescription for acetanilid is one suggested by Harlan. It follows:

℞—Acetanilidi, gr. viij (0.5 gm.)
Syrupi simplex, f℥ss (15.0 c.c.)
Spiritus frumenti, q. s. ad. f℥iij (90.0 c.c.)—M.
Sig.—Take one-half at once and the remainder in two (2) hours, if not relieved.

Keefe, of Chicago, suggests using dilute alcohol by which instantaneous and often permanent relief can be obtained in those cases where the tooth involved is one of the six upper anterior teeth. A prescription for the remedy is here given:

℞—Alcoholis,
Aquæ, āā f℥j (30.0 c.c.)—M.
Sig.—Use as directed.

This remedy is best administered in the form of a spray, using a watch-case atomizer for liquids, forcing the spray well back into the

nostril on whichever side the affected tooth is located. The application can be repeated as often as is necessary without any ill effects. In case an atomizer of any kind is not at hand, about fifteen minims (1.0 c.c.) of the remedy can be placed far back in the nostril with a suitable syringe.

The author does not wish to be understood as suggesting these various internal remedies in all cases of acute abscess. No therapeutist can tell exactly what internal drugs he would suggest without seeing the case and knowing the history; for there are many circumstances and conditions which modify the effect of drugs. Every remedy here mentioned, however, will be found useful in certain cases.

The Question of Extraction.—The question of extraction in acute alveolar abscess is a disputed one. Many writers recommend extraction as a speedy means of affording relief. Unfortunately, however, this is not always the solution of the problem; for if there be much osteomyelitis and the roots of the offending tooth be firmly imbedded, it is a rather dangerous procedure to extract during the developmental stage on account of the liability of a mixed infection, resulting often-

FIG. 7.—This shows a sequestrum which was exfoliated from the lower jaw. This result followed extensive infection, endangering the life of the patient, and ultimate necrosis from the extraction of a lower second bicuspid root, during the acute stage of an alveolar abscess. A mixed infection doubtless resulted from the laceration of tissues. It will be noticed that the sequestrum contains the mental foramina, which means, of course, that the inferior dental nerve, artery, and vein were severed. The lip on the affected side was partially paralyzed for a period of two or three years; and, in opening into the first bicuspid for the purpose of pulp removal for bridge-work, six months later the pulp was dead and just beginning to undergo the process of decomposition.

times in necrosis and frequently even threatening the life of the patient (see Fig. 7). If the root be a worthless one and easily extracted, its removal would doubtless afford free drainage for the abscess. There is no set rule governing extraction in these cases. The operator must be guided largely by the conditions as found. When extraction is resorted to, antiseptic mouth-washes should be prescribed and the case watched closely for a few days until we are certain that no complication will follow.

CHRONIC ALVEOLAR ABSCESS.

GENERAL CONSIDERATIONS.

There are two varieties of chronic alveolar abscesses—those without an external opening, except perhaps through a cavity in the offending tooth, and those which are discharging through a sinus. In these cases the decomposition of the pulp tissue is complete; the intermediate products (ptomains and amido-acids) have largely been broken up, and pus has been formed from the tissue and fluids surrounding the ends of the roots.

1. ABSCESS WITHOUT SINUS.

In treating that variety of alveolar abscess which is without an external opening, our method of procedure is somewhat different from that of an acute abscess. The tooth should be located; the rubber dam adjusted, and the teeth sterilized as before; then the pulp chamber is opened with a suitable round bur.

Disposing of the Pus.—Usually the pus flows freely, in which case it is permitted to do so, pressure being made on the tissue immediately over the end of the root. It should be our effort to mechanically evacuate as much pus at each sitting as is possible; for it is far better to remove pus in this manner, when it can be done, than to depend upon some chemic agent to destroy it, or upon nature to dispose of it

THERAPEUTICS.

The formocresol remedy will be useful here. The canals should be dried with alcohol as thoroughly as possible and the remedy on cotton hermetically sealed in each canal. It is, however, at this sitting, impossible to get the canals dry, and it is unnecessary to have them so, for the remedy will penetrate where moisture is present. This is an advantage over most remedies suggested for this purpose. In those cases where there is pain and swelling, together with a copious flow of pus which seemingly cannot be checked at this time, it may be necessary to evacuate the pus as completely as possible, loosely place in the canal a few shreds of cotton saturated with an antiseptic remedy (phenol compound), and then place in the cavity a pledget of cotton dipped in liquid petroleum. In no case should the cavity be left entirely

open; and the author desires to emphasize that it is seldom necessary to resort to this temporary expedient, if the proper time is spent in opening into the tooth and evacuating the pus. The dressing, in any event, should be changed every day until it can be removed without the pus flowing from the canals. When pus is forming rapidly at the end of the roots, the dressing soon becomes dissipated, the remedy loses its effect, and it is a loss of time to leave it in the canals more than twenty-four hours. Unless there be some complication, the pus formation should be checked in one or two treatments; at which time the formocresol remedy can be used in the same manner as in the treatment of putrescent pulps. It is now possible to change the dressings too often, however. The formation of pus has been checked, and the tooth should not be disturbed for at least one week or ten days, in order to give Nature a chance to effect a cure. If, at the end of this time, there is no evidence of pus and the case gives a favorable history, the canals can be filled. Should there, however, be a slight odor, although the tooth has not caused any trouble, we are not justified in filling the root. In these cases we can use a smaller amount of the remedy than is generally done. It should be remembered that the value of formaldehyd in any remedy to be used in the treatment of these conditions depends upon the power this agent has of uniting chemically with hydrogen sulphid, ammonia and poisonous ptomains. When these substances are not present, formaldehyd should be used with care and judgment. This precaution is mentioned here because formaldehyd is an irritating gas, and the amount of any remedy containing it should be used according to the conditions as found.

Weeping of Serum.—Quite frequently in these alveolar abscess cases, after the formation of pus has been checked, we have a weeping of serum from the canals. An excellent remedy to use in this case is eucalyptol to which thymol has been added in the following proportion:

℞—Thymolis,	gr. x (0.6 gm.)
Eucalyptolis,	f℥j (4.0 c.c.)—M.

Sig.—Dry the canal as much as possible and hermetically seal in the remedy.

If this remedy fails to check the secretion and the fluid is *serum,* not pus, no hesitancy need be felt as to filling the root, although the canals cannot be dried.

Complications.—Occasionally we find a chronic alveolar abscess of this variety where it is almost impossible to check the formation of

pus by applying drugs to the canals of the teeth. In those cases where the pus continues to flow freely when the dressing is removed at the third or fourth sitting, some complication can be expected. It is necessary then to force some stimulating agent through the apices of the roots, after the pus has been mechanically evacuated. The stimulating agent which the author uses almost invariably is a 50 per cent. solution of phenolsulphonic acid. In resorting to this means of bringing about a more acute condition, I desire to emphasize the necessity of first evacuating the pus as completely as possible before using the remedy, after which the agent should be placed in the canal on cotton and gently forced through the apices, then neutralizing that which remains with a solution of sodium bicarbonate, desiccating the canal with alcohol and hermetically sealing formocresol therein. It will be found that one or two treatments will usually check the formation of pus, after which the case can be treated as an ordinary abscess of this kind. In case this method fails to effect a cure, however, it will be necessary to surgically establish an opening through the overlying process and soft tissue and treat as for an ordinary discharging abscess—which treatment will now be considered.

2. ABSCESS WITH SINUS.

In those cases where the pus is discharging into the mouth through a sinus, our first duty is to locate the offending tooth. This is generally a simple matter for the reason that the sinus usually opens immediately over the tooth from which it comes. The pus in making its exit, however, follows the line of least resistance, and in some cases the condition of the process is such that the pus burrows forward or backward, and opens through the gum at a point several teeth removed from the one which is causing the trouble. These are the cases that are difficult to diagnose, especially where the abscess has been discharging for some time, when there is not much tenderness in any special tooth, and where there are several pulpless teeth on this side of the mouth. Sometimes two teeth containing putrescent pulps have a common sinus (see Fig. 16, page 322). In this case it would be impossible to heal the tract by treating only one of the teeth. The use of a silver probe will be valuable in all such cases. By gently working the probe forward or backward the sinus can be explored and the offending tooth or teeth located without drilling into innocent teeth—a discouraging procedure to both patient and dentist.

THERAPEUTICS.

The tooth being located, all that is necessary to effect a cure—there being no complication—is to force some bland solution through the root-canal and sinus, thus being certain it is well established; cauterize the tract with phenol compound or 95 per cent. phenol, preferably the former, hermetically seal in the canal or canals, the same agent used for this latter purpose or the formocresol remedy, and, at the subsequent sitting, the case giving a favorable history, fill the root.

Establishing Sinus and Disposing of Pus.—If the abscess is not discharging, and it is well in those cases where it is discharging, before adjusting the rubber dam, to enlarge the mouth of the sinus with a lancet or bistoury. By dipping the lancet in phenol, this may be accomplished with very little pain to the patient. After this is done, the rubber dam should be adjusted and the canals freely exposed. Now that the infection is past the end of the root, we need not hesitate to mechanically clean the canal at this sitting. The canals being clean, we are ready to establish the sinus. To do this we need a bland solution and a good hypodermic syringe with a long straight needle for anterior and a long curved needle for posterior teeth. There is an advantage in having a long needle, for the nearer the point is to the apex of the root, the less packing and force is required to send the solution through the sinus. Any bland solution can be used for this purpose. The author suggests normal saline solution or peppermint water to which two minims (0.12 c.c.) of phenol has been added to the fluidounce (30.0 c.c.). A piece of unvulcanized rubber of the proper size should be selected, softened in the flame, and a hole made in the center through which the needle is placed and inserted into the canal. The rubber should now be tightly packed around the needle and held on either side with flat nose pliers, when pressure can be made on the piston or the syringe and the solution forced through the sinus. This should be repeated several times, care being taken not to break the needle in the canal. If convenient, one corner of the dam can be raised, exposing the mouth of the sinus to view. There are two objects in forcing a bland solution through the sinus: one is to be certain that it is open, and the other is to mechanically wash out the pus. Whenever pus can be mechanically removed, it is always better to dispose of it by this means rather than to do so by the use of some chemic agent. It has been common practice after the sinus is established to use a solution of hydrogen dioxid. This is often a dangerous procedure and *always unnecessary* if the first solution has been used in sufficient quantity.

Cauterizing Sinus.—For cauterizing the sinus in simple cases 95 per cent. phenol has been largely employed. An excellent preparation to use for this purpose is the phenol compound remedy. With the sinus well established, it is never necessary to place either of these solutions in a hypodermic syringe. The author knows of several instances where this has been tried with disastrous results. The remedy can be applied to the canals on cotton, when, with unvulcanized rubber and a suitable instrument, it can be forced through the sinus. Alcohol is a positive antidote for phenol; the alcohol bottle should therefore be in a convenient place so that the remedy used in the canal can be neutralized at once when it appears at the mouth of the sinus. If this has been well done, it matters little what drug or remedy is sealed in the canal. The phenol compound or the for-

FIG. 8.—This skiagraph, taken by Ream, illustrates an interesting case, which was not treated by the author and the history is therefore negative. The skiagraph shows that the canal is not properly filled, while the root carries a well adjusted porcelain crown. It is futile to attempt to cure an abscess under such conditions by simply injecting such agent, as bismuth paste through the sinus into the affected area. The crown must be destroyeds the canal reopened, when one or two treatments of phenolsulphonic acid should effect a cure. Had the skiagraph shown that the canal was properly filled, external curettement would have been the proper treatment. In fact, had the canal been properly filled the abscess, in all probability, would not have developed.

mocresol remedy will give excellent results if hermetically sealed in the canals for about one week.

In cases of long standing when we can reasonably suspect a roughening of the end of the root or process through which the pus has been discharging, it is good practice to use, as the cauterizing agent, 50 per cent. solution of phenolsulphonic acid, and in stubborn cases the pure acid can be employed (see Fig. 8). This agent, as heretofore made, contained an excess (15 per cent.) of uncombined sulphuric acid, which rapidly disintegrated cotton; therefore it was necessary to place it in the canal on threads of asbestos, wool fiber, or silk, and force it

through the sinus in the usual manner, cauterizing the tract, and also stimulating the sluggish cells in the area to healthy activity. It is now possible to procure phenolsulphonic acid with less than 1 per cent. of free sulphuric acid (see page 89). This product can be used with cotton.

It is sometimes difficult to established the sinus, especially on molar teeth. In all such cases where there is no complication, the case can be nicely treated with formocresol solution as outlined under Treatment of Abscess Without Sinus.

The author does not believe in delaying the root filling long after the sinus has been cauterized in uncomplicated cases; for by filling the root as soon as we are certain that the sinus is healing, we avoid a weeping condition, which usually exists and which is annoying when this part of the treatment is delayed for one month or six weeks as advocated by some writers. In these cases where the first treatment has been thorough, and the case gives a favorable history, the root should be filled at the second or, at most, at the third sitting. If the case does not yield to the above treatment, some complication may be expected.

COMPLICATIONS.

There are several complications of chronic alveolar abscess of both varieties, with and without a sinus, where it is necessary to modify or change the general method of treatment to meet the conditions as they exist. For instance, in the case of an abscess without a sinus where we can reasonably suspect, and where the indications point to, a roughening of the end of the root, we ought not to expect to cure the case by simply sealing remedies within the canals of the tooth. If we do, we are expecting too much of drugs. Again, in a case of an abscess with a sinus where the pus has been discharging for several months, with the not unusual result that the end of the root or process through which the pus has discharged has become roughened, we should not expect to effect a cure by forcing phenol or the phenol compound through the sinus, because such agents as these have no action whatever on the bony structures. The author desires to emphasize here the value of the skiagraph in determining the extent of involvement and the nature of the complication. It is not always a positive means of diagnosis, but it is a material aid (see Figs. 9 and 10).

1. **Denuded End of Root.**—One complication we may expect to find in abscesses of long standing, especially in the variety without a sinus, is where a large area of tissue in the apical space has been re-

sorbed or broken down, denuding the end of the root and the denuded portion projecting into the absorbed area (see Fig. 11). It is possible, in these cases, to make pressure over the end of the root and mechanic-

FIG. 9.

FIG. 10.

FIG. 9.—This skiagraph, taken by Lewis, shows an abscess with extensive resorption of alveolar process between the central and lateral roots, both of which had been previously filled and carried jacket crowns. The skiagraph shows the later root perfectly filled and the abscess caused by the imperfectly filled central. These cases are often difficult to diagnose.

FIG. 10.—This skiagraph, taken by Lewis, shows a similar case to that illustrated in Fig. 9. It was difficult to determine whether the abscess came from the central or lateral root. The skiagraph shows the lateral root over-filled, but the abscess coming from the central.

ally evacuate all of the pus above the apices; but we cannot expect by this means to evacuate the pus below and surrounding the end of the root projecting into the space. In this case we must do one of two

FIG. 11.—This skiagraph, taken by Ream, shows a typical abscess without a sinus which developed from an imperfectly filled root of a lateral incisor.

things: Force some stimulating agent through the end of the root into the infected area, to create a more acute condition; or surgically establish a sinus through the overlying process and soft tissue, and treat

as an ordinary discharging abscess. While the author does not hesitate to adopt the latter method if necessary to effect a cure, it will be found that the use of a stimulating agent will generally suffice in these cases. The agents recommended are a 50 per cent. solution of phenolsulphonic acid or a 15 per cent. solution of trichloracetic acid. In using either of these solutions, the pus should first be evacuated as much as is possible; then the solution selected can be placed in the canal and gently forced through the apices and formocresol sealed in the canal. One or two treatments will usually be sufficient to check the pus formation, when the case can be treated in the ordinary manner. If, however, this does not effect a cure, it is a waste of time to prolong such treatment, and recourse should be made to surgical methods, which will be discussed later.

2. **Resorbed or Roughened End of Root.**—Another complication of both varieties of chronic alveolar abscess is where the pus has stood in contact with the end of the root sufficiently long to cause resorption,

FIG. 12.—This shows an upper second bicuspid exfoliated by Nature with the entire surrounding alveolar process attached. This result followed a slight traumatic injury to the part, shortly after the pulp had been removed by pressure anesthesia. The first bicuspid ultimately became so loose that its removal was necessary. The author was able to elicit a previous history of syphilis, the disease having been cured for a number of years.

leaving a roughened end which irritates the tissue and prevents healing. Sometimes, also, the process through which the pus has burrowed is left with sharp edges. In all such complications, surgical treatment is especially indicated. These cases generally yield nicely to the removal of the denuded and roughened root-end, and the thorough curetment of the affected area.

3. **Encystment of Root.**—A difficult complication to treat is where an abscess occurs on a root, the end of which has become encysted from deposits, excementosis or other causes. In order to effect a cure in these cases, it is necessary to establish a sinus and remove the deposits, excise the root-end, or extract the tooth. The method of excising the root-end will be discussed later.

4. **Involving Bone.**—Every acute and chronic alveolar abscess in-

vites bone complication. During the progress of the abscess the bone-marrow becomes infected by the pathogenic bacteria and is broken down into pus. If extraction is resorted to and laceration of the soft tissue and alveolar margins results, a mixed infection is liable to follow, as has been previously explained (p. 311, Fig. 7). The germs are highly virulent, and among which are frequently found the diplococcus pneumoniæ and the tubercular bacilli.

In these cases it is necessary to see the patient frequently, washing the part with warm antiseptic solutions and covering the entire exposed process with the euroform paste or other stimulating remedies. The orthoform will control the pain and the iodin liberated from the europhen will stimulate and disinfect the part. If gauze is used in applying the paste, it should be changed frequently; for, if left long, it invites further infection, even when saturated at first with the oleaginous

FIG. 13.—This skiagraph, taken by Lewis, shows bismuth paste which was injected into an abscess pocket. Extensive caries of bone resulted from a dead pulp in the cuspid tooth. An opening was made both labially and lingually, the part curetted and packed with euroform gauze. The second day after operation the bismuth paste was injected, when the skiagraph was taken.

paste. After the pain subsides bismuth paste may be freely injected every few days.

5. **Extensive Caries or Necrosis.**—Bone infection from alveolar abscesses often results in either caries or necrosis of bone. Pus is formed from the breaking down of the tissues and fluids, and, in case of caries, escapes through several sinuses (see Fig. 13). The porous dead bone may be detected by a pointed steel probe. In necrosis the parts involved die *en masse*, and the sequestra are finally loosened and gradually work out as one large or several small pieces. In cases of syphilitic history, even if the case has long been considered cured, there is a great tendency toward necrosis (see Fig. 12). The treatment here is largely surgical. The dead bone must be removed, after which the

parts should be kept clean and stimulation used until healed. It is generally best in cases of necrosis to wait for Nature to separate the dead from the living bone. A 50 per cent. solution of phenolsulphonic acid hastens the formation of the sequestrum; after the dead bone is removed bismuth paste should be injected until the part heals.

6. **Involving Vault.**—Still another complication often difficult to cure is where the pus has worked its way through the lingual plate of bone and involves the vault of the mouth (see Figs. 14 and 15). The dense fibrous tissue covering the vault is very tough, and the pus often

FIG. 14.

FIG. 15.

FIG. 14.—This skiagraph, taken by Ream, shows a large abscess cavity under the floor of the nasal and antral cavities, the result of the death and decomposition of the pulp in the lateral incisor. The dark spot shows the outline of the cavity which had been injected with bismuth paste from a lingual opening. To cure the case it was necessary to open from the labial, excise the lateral root and thoroughly curett the affected bone. After the operation the case was first packed for 24 hours with euroform gauze to control the pain, followed with the injection of bismuth paste until granulation filled the cavity.

FIG. 15.—This skiagraph, taken by Ream, shows the case, illustrated in Fig. 14, immediately after the surgical operation. In excising the root, the end dropped into the deep lingual pocket where it was difficult to find and remove (see a). The skiagraph aided materially as it verified the presence of the root-end and its location.

separates the periosteum from a considerable area of bone before ultimately discharging into the mouth. Generally a lancet is required to evacuate the pus. In treating these conditions it is essential to explore the affected area, using a sharp steel instrument in order to determine whether there is caries or necrosis. Unless too much bone is involved, the case can be successfully treated by first making a liberal opening with a sharp bistoury and, if necessary, breaking down the sharp edges of bone, through which the pus has burrowed, with a round bur having a long shank, after which the sinus should be established in the usual manner, using a considerable quantity of the bland solution. Now dry the canal and force through the sinus full strength

phenolsulphonic acid. Sometimes it is advisable to place a piece of blotting-paper soaked in liquid petroleum over the lingual opening when forcing the acid through. This causes the agent to spread and come in contact with the entire area involved. Alcohol and the oils will neutralize any excess of the phenolsulphonic acid that may get on the other tissues of the mouth. This treatment should be repeated as often as the case demands. When there is no evidence of pus and the case has healed sufficiently so that there is only a watery discharge, the root can be filled.

7. **Secondary Abscess Pocket.**—Occasionally we find an abscess of the discharging variety which does not yield to our general treatment, yet we are reasonably certain that none of the complications so far mentioned are present. In these cases we can suspect a *secondary abscess pocket.* This is especially true where the sinus opened into the mouth several teeth removed from the affected tooth. This pocket can usually be discovered by the aid of a small silver probe. The treatment is simple—all that is necessary is to open the pocket, wash it out

FIG. 16.—This skiagraph, taken by Ream, shows the involvement of the upper left central and lateral incisors, with a common sinus. Both teeth carried perfectly adjusted porcelain crowns. The skiagraph not only shows the involvement of both teeth, but also the roots are properly filled. The treatment here is purely surgical and means the currettement of the affected area.

first with a bland solution, then inject 50 per cent. phenolsulphonic acid. In using phenolsulphonic acid in such cases it cannot be injected through the tooth, therefore it is necessary to use a syringe—a glass syringe with an asbestos-packed plunger and a gold or a platinum needle should be used.

8. **Involving Two or More Teeth.**—It is not an uncommon thing to find two or more teeth involved with a common sinus. Such a case is illustrated in Fig. 16. This figure also shows the importance of skiagraphy in the diagnosis of these complicated abscess conditions.

Here it would be impossible to cure the case by simply treating either one of the affected teeth. In this particular case, the root canal of both teeth having been properly filled, external curetment is the treatment indicated.

9. **Involving Antrum.**—The pus in making its exit follows the line of least resistance, and sometimes it is easier to work its way through the floor of the antrum than through the labial or lingual plate of bone. The treatment of this complication is of sufficient importance as to merit discussion by itself, which will be considered later, but in this connection it is well to remember that so good an authority as Kyle, viewing the question from the nasal side, finds that fully 50 per cent. of antral diseases are of dental origin.

SURGICAL TREATMENT OF CHRONIC ALVEOLAR ABSCESS.

In all complicated abscesses which will not yield to the medicinal treatment as outlined in the preceding pages, we can often save the affected tooth and make it healthy and useful by adopting surgical methods. Thorough curettement of the area involved and, if necessary, excision of the root-end will save many teeth, such as have been too frequently lost in the past by extraction. Many dentists have preferred to extract the tooth in these complicated cases rather than undertake to effect a cure by means of surgery. It is because of this fact, and with the hope of stimulating a greater interest in this phase of the subject, that the author includes herein a description of his method of treating these cases.

Indications for Surgery.—The surgical treatment is indicated in those cases where the medicinal treatment has failed to effect a cure, or where the root-canal has been thoroughly filled and the abscess develops subsequently. Especially is surgery indicated in this latter class of cases, if the affected tooth-root is firm in the jaw and has a good natural crown or carries a well-adjusted artificial crown. It is always best, where practicable, to have a skiagraph taken to aid in determining the area involved and whether or not the root-canal has been properly filled.

In those cases of failure to cure by treatment through the canal, and where surgery is to be undertaken, the author advises filling the canal, using gutta-percha for the purpose, before operating, especially if the root-end is to be excised; for, while it can be done, it is rather difficult to close the generally large apical opening of the root after excision.

This operation should be done under the most aseptic conditions;

the hands of the operator and assistant, the site of operation, as well as all instruments used should be sterilized; and, in the absence of a skiagraph, a thorough exploration should be made before operating that the amount of process and root involved may be noted. The instruments used here were selected for the purpose from the surgical supply houses, some of which have been modified by the author to better meet our demands. They are all-metal instruments and can be sterilized by boiling.

The Anesthetic.—The success of the operation will depend entirely upon the thoroughness with which it is done. It is therefore highly essential that the patient be assured that the operation not only can but *will* be performed with *very little pain.* This will be interesting to the patient and will increase his confidence in the operator. It is unnecessary to administer a general anesthetic, as the area can be completely anesthetized by the proper use of local anesthetics. For all such operations the author uses the formula given on page 278, and at the time of making the injection 2 minims (0.12 c.c.) of a fresh 1–1000 solution of adrenalin chlorid is added to 30 minims (2.0 c.c.) of the anesthetic solution.

With a strong all-metal syringe, this solution is injected on either side of the abscess area and also down deep into the pocket. If pressure is made over the point of the needle with the forefinger of the left hand as the solution is being injected, only a small amount of the solution will be necessary to thoroughly anesthetize the part. It is essential that the area be completely anesthetized; for we have assured our patient that there would be practically no pain, and if this assurance is carried out, we are more likely to do our work so thoroughly that there will be no question as to the ultimate success of the operation. It is

FIG. 17.

but natural that most operators will do their work more thoroughly when the factor of pain is eliminated. The author desires to speak plainly on this point; for it will be far better for all concerned not to undertake the operation than to fail to do it with that degree of thoroughness which means success.

The Incision and Control of Hemorrhage.—When the part is anesthetized and only one tooth is involved, a vertical incision is made about one-half or three-quarters of an inch in length, directly

over the affected root. In case two teeth are involved, it is necessary to make a circular incision. A bistoury, such as is illustrated in Fig. 17, is used, and care should be taken to make the incision as high as possible (if the case is an upper tooth) so that it stops about on a line with the floor of the necrotic area. If the in-

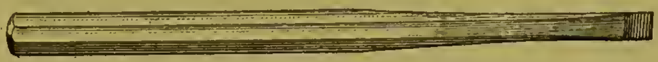

FIG. 18.

cision is made any lower than this, the healthy process is likely to be left exposed, when it is more difficult for the tissues to close over this part. After the incision is made and sponged to check the primary hemorrhage, a flat bone chisel (Fig. 18), used as a periosteotome, is

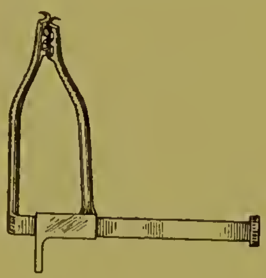

FIG. 19.

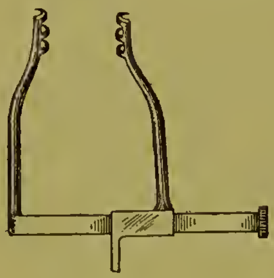

FIG. 19*a*.

employed to separate the periosteum from the bone for about one-fourth inch on either side of the incision. The part is again sponged and a tissue retractor (Fig. 19) is firmly adjusted. The arms of the retractor can be spread so that the soft tissues overlying the bone can be held back, and at the same time the pressure produced controls the hemorrhage from this source. The operation from now on should be

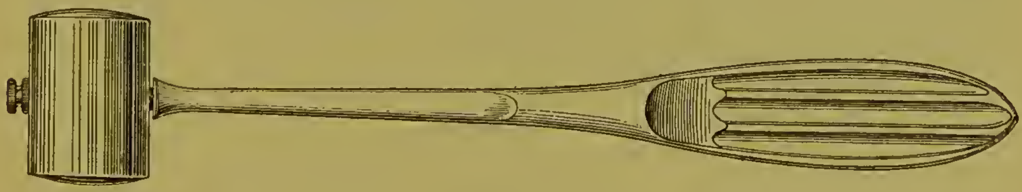

FIG. 20.

practically bloodless; especially is this true if adrenalin chlorid was added, as suggested, to the local anesthetic solution.

Exposing the Area Involved.—We now have the alveolar process over the root-end exposed to view, unless this has been destroyed by the necrotic process, which is frequently the case. Where it has not

been destroyed, it is removed by means of bone chisels and mallet. The latter is shown in Fig. 20. The use of chisels and mallet was suggested to the author by Shamberg, of New York. The flat chisel is used across the lower part of the opening and along either side, by the claws of the retractor. To chisel across the upper part of the opening, a half-round chisel is used (Fig. 21). The loosened bone is now

FIG. 21.

removed when the root-end and area involved should be exposed to view. We are now able to make an ocular examination and determine whether the case simply needs curettement or whether the root-end should also be excised. If the necrotic area extends below the apex of the root, it is always best to excise as much of the latter as is involved, being certain to reach healthy bone on either side. It makes no difference whether the end of the root is left flat, round, or slanting, as long as healthy bone is reached.

Before excising the end, it is best to drill on either side with a fissure bur. If this is done the root-end, after excision, can be easily removed

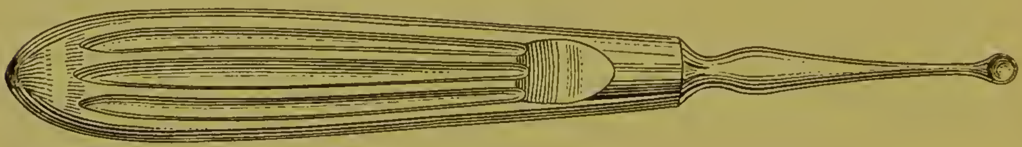

FIG. 22.

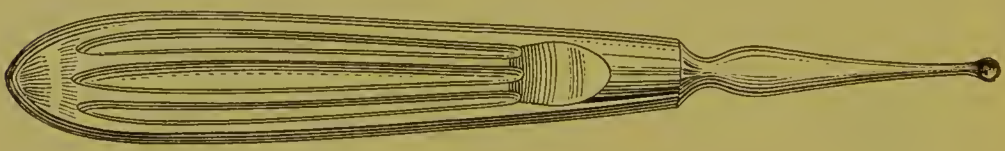

FIG. 23.

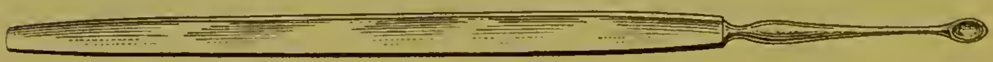

FIG. 24.

with an ordinary pair of pliers. The exposed end can now be excised with sharp fissure or cross-cut burs. Several such burs should be in readiness as they soon clog in a wet field.

Curetting the Area.—After removing the excised root-end, which

as stated above is an easy matter, the remaining end of root should be made smooth, using a large round bur for the purpose. The affected area is now thoroughly curetted, removing any carious or necrosed bone. Here bone curettes of varying sizes (Figs. 22, 23 and 24) are employed. This is the only part of the entire operation which may be at all painful, and the patient should now be so informed. Even here the curetting can be done with very little pain, if the anesthetic has been deeply injected.

Washing and Packing the Wound.—With the end of the root smooth and cut down to healthy process on either side, the area thoroughly curetted, the wound should now be washed with a warm antiseptic solution. This may be done without removing the retractor. Following the washing of the wound, the moisture should be absorbed

FIG. 25.

FIG. 26.

FIG. 25.—This skiagraph, taken by Ream, shows a long standing abscess on an upper left lateral. The root had been filled with lead. The dark line is a silver probe which was placed in the sinus while skiagraph was taken.

FIG. 26.—This shows the same case the day after the root-end was excised. The pocket is now ready to be filled with bismuth paste.

and the area cauterized with a 50 per cent. solution of phenolsulphonic acid. The wound is now packed with sterile gauze, saturated with euroform paste. The orthoform in this paste will absolutely control the pain which nearly always follows the use of local anesthetics and the cutting in bone, while the europhen, giving off iodin, will stimulate the cells and hasten granulation; the oleoaginous vehicle (liquid petroleum) keeps the saliva, laden with bacteria, out of the wound.

Subsequent Treatment.—The patient should be instructed to keep the mouth as clean as possible by using an antiseptic mouth-wash; and after the initial packing, which should be left only twenty-four hours, bismuth paste is injected every few days until granulation fills the cavity with healthy tissue.

Skiagraphs showing cases in the author's practice, before and after treatment, are illustrated in Figs. 25, 26, 27 and 28. See also Fig. 29. In those cases where the lingual plate of bone has been destroyed and a deep pocket is present, or where the abscess involves

FIG. 27.

FIG. 28.

FIG. 27.—This skiagraph, taken by Lewis, shows a chronic alveolar abscess on an upper right central. The canal was filled and the root carried a good porcelain crown.

FIG. 28.—This shows the same case four days after excision of the denuded root-end and the curettement of the affected area.

the antrum, care should be taken that the root-end, when excised, does not drop into the deep pocket or antral cavity, as it is often difficult to locate and remove. Such a case is illustrated on page 321 in Fig. 15. It is a good plan in such cases to drill a small hole through the end of

FIG. 29.—This skiagraph, taken by Lewis, shows an abscess which developed on the distal root of a lower molar, after the mesial root had been previously excised and a bridge adjusted. Thorough curettement and keeping the pocket filled with bismuth paste cured the condition. The abscess was of the pericemental variety, and was doubtless caused by injury to the alveolar process and pericemental membrane, produced in the removal of the excised mesial root.

the root through which a small wire may be inserted and bent to form a hook. Then when the root-end is excised, it can be easily removed with the wire without danger of being lost.

Other complications are illustrated in Figs. 30 to 33.

Whenever the operator is in doubt as to the best means of treating complicated alveolar abscesses, he should never hesitate to consult

FIG. 30.

FIG. 31

FIG. 30.—This shows a tumor which developed in the apical area of a central incisor, which carried a Richmond crown. The tooth had been improperly treated.

FIG. 31.—This shows a central incisor carrying a Richmond crown. Pink gutta-percha can be seen in the apex of the original (*A*), showing that the root was perfectly filled at first; but in drilling for the dowel subsequently the dentist punctured the root, afterward forcing gutta-percha through the puncture (*B*). An abscess developed, doubtless from lack of asepsis.

FIG. 32

FIG. 33.

FIG. 32.—This skiagraph illustrates a case where three of the lower incisors contained dead pulps, causing an abscess with a common sinus which opened externally under the chin, just to the right of the median line. The dentist had been treating the abscess by washing through the left central only and sinus, finally filling the root. The case failing to heal after several months treatment, the patient was referred. The skiagraph shows, as stated, that the right central and lateral are also involved. By sterilizing the contents of the canals of these teeth and forcing phenolsulphonic acid (25 per cent.) through the sinus, the case yielded at once.

FIG. 33 shows the external sinus before treatment.

with a practitioner who has had more experience in treating these cases. Such a course cannot be construed as a lack of knowledge, but is evidence of conservatism and progress.

TREATMENT OF PUTRESCENT PULPS AND ABSCESSES IN DECIDUOUS TEETH.

In treating the conditions under consideration in the mouths of children, it is necessary in most cases to modify our usual method of treatment. Our first duty here is to gain the confidence of the child. If the abscess is associated with a deciduous molar which we would desire to save for at least a year or two, it can be treated nicely in the following manner: After gaining the confidence of the little patient the mouth can be rinsed with an antiseptic solution—one which has a pleasant taste. Then open into the pulp chamber and place a pledget of cotton in the opening. Now mix on one end of the cement slab thymolized calcium phosphate and the formocresol remedy, making a stiff paste. On the other end of the slab have a quick-setting cement ready to mix. Again rinse the patient's mouth and, keeping the cavity as dry as possible, gently pack the paste into the pulp chamber and flow the cement over it, filling the cavity. It is remarkable how rapidly these abscesses will heal and remain quiet when treated in this manner, provided, of course, there be no caries or necrosis of bone, which condition is rarely found in the mouths of children as the result of abscess from deciduous teeth. If it is desired to keep the tooth in the patient's mouth for more than a year, it is better to neutralize the putrescence with formocresol as usual, when the root-canals can be flooded with eucapercha compound and the entire cavity filled with gutta-percha. The gutta-percha filling, if properly inserted, will last as long as it is necessary to save the tooth, even in occlusial cavities where it is exposed to the stress of mastication.

PERICEMENTAL ABSCESS.

GENERAL CONSIDERATIONS.

All of the alveolar abscesses which we have discussed thus far have been the result of an infection in the apical area, the infection being due to pathogenic bacteria, poisonous ptomains and irritating gases, which have escaped from a putrescent root-canal. There is, however, an abscess that occurs in the alveolar region about the roots of teeth, not caused from the source mentioned. This particular kind of abscess occurs in connection with live teeth; not necessarily so, however. There is a progressive breaking down of the pericemental membrane, and in dental literature it is called a *pericemental abscess.* The cause of this particular kind of abscess is rather vague; but it is generally supposed to be due to some traumatic injury. It frequently occurs on the mesial, labial or distal surface of the roots of the anterior teeth involving most of the surface. The lingual surface of these teeth is seldom involved. They have also been known to occur between the roots of molar teeth, especially upper molars. It may discharge through a sinus near the apical end of the roots or at the gum margin; in the latter case it resembles a pyorrheal pocket.

THERAPEUTICS.

For convenience in outlining our treatment for a pericemental abscess, the condition may be classified as *acute* and *chronic.* As a rule, there is very little pain associated with either variety of pericemental abscess. In the acute form, which, as such, is extremely difficult to diagnose, the patient will complain of "something being wrong with a particular tooth." About all that can be done therapeutically with the acute form is to pacify the patient as best we can, until the acute abscess develops into the chronic variety, when pus is formed and discharges and a sinus is established; thus the diagnosis is more easily made. In those cases where the sinus opens on the labial or buccal surface of the gum and not at the gum margin, care should be exercised in the diagnosis so as not to confuse the condition with an abscess of the ordinary variety, and open into vital teeth. A case where an incorrect diagnosis was made is illustrated in Fig. 34.

If the abscess occurs on the anterior teeth where the area involved can be curetted and cauterized, it will generally yield to the treatment;

but the treatment of a chronic pericemental abscess on molar teeth is at best a discouraging procedure. If it is possible to thoroughly curette the area the tooth can be saved, providing the surrounding surfaces are kept clean. In those cases where the area can be reached, an opening, if necessary, can be made through the gum, the root thoroughly scraped and polished; then, after washing out the abscessed area, it should be cauterized with some cauterizing agent. Nothing gives better results

FIG. 34.—This skiagraph, taken by Ream, partially shows the result of an incorrect diagnosis, where a pericemental abscess was mistaken for an alveolar abscess. The abscess occurred between the roots of the upper right central and lateral incisors with a sinus opening on the labial midway between the gum margin and the apex of the central incision. The case gave a history of having received a blow on these two teeth about two months previous. The dentist, thinking the pulp in the central was dead, deliberately opened into the vital tooth. The patient then went to another dentist who attempted to remove the pulp by pressure anesthesia. It was difficult to anesthetize and a remnant was left in the apical area. Acute pericementitis followed and nitrous oxid and oxygen was administered and the remant removed. This only aggravated the pericemental trouble; the cavity was left unsealed and the crown of the tooth became dark blue in color. The patient was now referred. Two treatments of phenol compound cured the pericementitis, when the root was filled. Subsequently the tissue about the abscess was anesthetized, the area curetted, and the wound packed for twenty-four hours with sterile gauze saturated with euroform paste. Two subsequent injections of bismuth paste cured the case; after which the color of the tooth was restored by sealing caustic pyrozone in the cavity, when a gold inlay was inserted. The patient in this instance was a lady, and when we recall that the tooth involved was an anterior one, the seriousness of the mistaken diagnosis becomes all the more apparent.

than phenolsulphonic acid. With a proper glass syringe and a gold or platinum needle, the remedy can be injected into the abscess pocket. One thorough treatment should effect a cure. In curetting these cases it is far better to go a little beyond the affected territory rather than fail to remove all of the affected tissue and have the abscess recur. Where the abscess can be reached, thorough curettement and cauterization will effect a cure. That portion of the pericemental membrane which has been destroyed will perhaps never be regenerated, but if we succeed in having granulation fill in the area involved, even though the membrane is not regenerated over that particular surface of the root, the tooth can be saved for a considerable length of time.

FILLING ROOT-CANALS.

GENERAL CONSIDERATIONS.

There are so many different methods of filling root-canals, and there seems to be such a variance of opinion as to the best method of performing this operation, that it is with a degree of hesitancy that the author attempts to discuss this subject. This operation stands as a sort of dividing line between the subjects of *therapeutics* and *operative dentistry* proper. In discussing this subject, the author will present the therapeutic aspect, and describe a method of procedure which has proved successful in his practice.

It will be remembered that three factors were emphasized under the Removal of Pulps and the Subsequent Treatment, viz.:

1. Establish and maintain asepsis.
2. Preserve the color of the tooth.
3. Thoroughly fill the canal.

The author suggests filling all canals, which are large enough for a broach to enter, with gutta-percha in the manner which will be subsequently described. In connection with the preservation of the color of the tooth, it should be mentioned that *white base plate gutta-percha* should be used, especially for the purpose of dissolving in eucalyptol compound, making *eucapercha compound.* If this white substance is forced into the tubuli of the crown of the tooth, as it is liable to be, it will not change the color of the tooth-structure as would the pink gutta-percha. A great many dentists have been moistening the canal, previous to filling with gutta-percha, with *oil of eucalyptus;* and, as a result, much unnecessary pericementitis has followed this operation. If oil of eucalyptus is used at all, the refined oil only should be selected; and far more satisfactory results will follow the use of *eucalyptol*, the most volatile constituent of oil of eucalyptus. While eucalyptol is irritating, it is not nearly so much so as is oil of eucalyptus. The author suggests modifying the irritating property of eucalyptol and enhancing its antiseptic power by combining menthol and thymol, as suggested in the prescription for eucalyptol compound in the discussion of Nonseptic Pericementitis. (Page 296.)

In this proportion, the agents added do not interfere with the

solvent power of eucalyptol for gutta-percha; but if the amounts are increased to any appreciable extent, this does not hold true.

In filling root-canals it is always the safest practice to adjust the rubber dam, for asepsis must be established and maintained. The same agents can be used for sterilizing the teeth after the dam is adjusted as were described in removing pulps by the anesthetization method. The canals should be aseptic before the operation is attempted. If there is any doubt in this regard, the operation should be deferred until the canals are in such a condition.

Filling Large Canals.—In filling large canals, especially those in connection with which abscesses have been treated, where the apex is large and where we ought not to expect to get a response from the patient when the gutta-percha cone reaches the apex, on account of the resorption in the apical area, it is best to measure the canal and then use one cone which approximately fits the canal rather than use two or three smaller cones with the possibility of forcing one through the apex and into the apical area. There is almost as much danger of forcing the root filling too far in large canals, as there is in not forcing it far enough in small canals. To measure the canals, cotton can be tightly wrapped around a smooth, sterile broach and inserted. When by repeated trials the cotton fits the canal, a cone can be made of white base plate gutta-percha, which is slightly smaller than the tightly wrapped cotton. The canal should now be moistened with eucapercha compound, working the latter up or down into the canals with a fine smooth broach, exhausting the air. If cotton is wrapped around the broach used for this latter purpose, only a few shreds should be used; for we should avoid making a piston out of the broach and thus defeating the means of exhausting the air. This accomplished, the cone can be slowly and gently pressed to place. In filling large canals from which live pulps have recently been removed, the patient will generally flinch before the cone reaches the apex. When this occurs, we should wait a few moments, when the cone can be gently pressed much farther without causing the patient to flinch a second time. If these precautions are observed, they will be the means of preventing much of the pericementitis following the filling of root-canals.

Filling Small Canals.—In filling all canals where we can enter nicely with a smooth broach, it is best to follow the technic outlined above, using a cone which will enter the canal. However much we may regret it, there are canals, especially in the molar teeth, so small and tortuous that even a fine, smooth broach will not enter, at least to any depth. It is useless to try to fill such canals with a gutta-percha

cone. The methods of enlarging the canals by the use of acids and caustics, as referred to in connection with the destruction of pulp tissue in such canals, can be employed; but it is not always advisable to enlarge them sufficiently to admit a small cone. After the larger canal or canals in a multi-rooted tooth are filled in the ordinary manner, the smaller ones can be moistened with eucapercha compound and this worked up or down into the canal. This process should be kept up for some time. The sides of the pulp chamber can now be moistened with eucalyptol compound and a piece of base plate gutta-percha, selected and softened in the flame, can be packed into the pulp chamber, when pressure can be made toward the small canals and the plastic gutta-percha forced into them. This is much better practice than simply filling the mouth of the canal with a gutta-percha cone. If the canal is so small and tortuous that even a small broach will not enter, and if it cannot be enlarged by the use of acids or caustics, as referred to previously, it is good practice to make a paste of formocresol and thymolized calcium phosphate, placing the paste over the mouth of the canal, and, after working it up or down as best we can and absorbing the excess of liquid, covering it with cement.

As previously mentioned, there are many methods of filling root canals by which good results are attained. The method here outlined has served the author well. In closing, I desire to say that no reasonable amount of time should be considered lost in the treatment of teeth preparatory to the insertion of the final root-canal filling.

DISCOLORED TEETH.

GENERAL CONSIDERATION.

In the discussion of the methods of removing pulps from teeth and the subsequent treatment, the treating of putrescent pulps and the various kinds of alveolar abscesses, the author endeavored to emphasize the necessity of *preserving or restoring the color of the tooth.* There is, perhaps, nothing more annoying to a conscientious dentist and to an appreciative patient than a discolored tooth in the patient's mouth. If the precautions, which have been mentioned throughout this work with reference to this factor, are observed in the treatment of teeth, the necessity for bleaching may often be avoided; for after all that has been written on this subject is studied, it must be admitted that the most successful method of bleaching teeth is to so treat them that they will not need to be bleached.

Sources of Discoloration.—There are three principal sources of the discoloration of tooth-structure, viz.,

1. Pulp decomposition.
2. Remedial agents.
3. Metallic fillings.

The greatest source is that of pulp decomposition. Many teeth containing putrescent pulps are discolored before the patient presents for treatment. In those cases where the color is not lost the putrescent condition can be corrected and the color preserved by the method of treatment outlined under Putrescent Pulps.

Occasionally, however, teeth have been observed to assume a pinkish hue shortly after some traumatic injury, rapid regulation, or after some irritating drug had been applied to a small exposure of the pulp, as, for instance, arsenic trioxid. Kirk has offered a plausible explanation for the cause of this immediate discoloration. He says: "It is now known that the pink staining of the tooth is brought about by a rupture of the stroma of the red blood disks liberating their contained hemoglobin, which dissolves in the plasma, forming a solution of hemoglobin which readily penetrates the dentinal tubuli, the lumen of which is of insufficient diameter to admit the unbroken red corpuscle. This pink discoloration resulting from the

infiltration of hemoglobin solution represents the first stage of tooth discoloration. The pink stain readily undergoes alterations, later on assuming a brownish tint, due to the breaking down of the highly complex molecule of hemoglobin into a reduced product known as hematin."

Manner of Discoloration.—There are two ways by which the discoloration is produced, *i.e.*, by solutions which stain the cement-like substance uniting the tubuli and by the ingress into the tubuli of insoluble coloring substances. For instance, many remedial agents in solution, such as oil of cassia, silver nitrate, etc., have the property of staining the cementing substance and producing discolorations; while the sulphids formed from certain metals, as, for example, in amalgam fillings, produce discoloration by virtue of being forced into the tubular structure of the dentin. If more care were taken in selecting remedial agents, used in the treatment of teeth, which would not stain the tooth-structure, and if high-grade alloys were selected in making amalgam fillings, the cavity properly prepared, amalgam inserted and polished when set, there would be few teeth discolored from these sources. But, as has been stated, many teeth containing putrescent pulps are discolored before the patient presents for treatment; and, inasmuch as this is by far the greatest source, it is well to try to ascertain definitely the true cause of the discolorations from this source; for it is difficult and unsatisfactory to try to bleach a tooth when we have no knowledge of the nature of the pigment we are trying to bleach.[1]

Principle of Bleaching.—The principle which governs the successful bleaching of teeth is to chemically change the molecule of the pigment in such a manner as to destroy its color, or chemically change the insoluble coloring substance to a soluble form, when it can be washed out of the tooth-structure.

Important Factors.—When a case presents for bleaching there are three important factors to be determined:

1. Ascertain, if possible, the cause of the discoloration.
2. Decide whether or not the color can be successfully restored.
3. The selection of the proper bleaching agent with which to restore the color.

The general cause of the discoloration can usually be ascertained from the history of the case as related by the patient. Whether or

[1] The author has explained the chemistry of tooth-discoloration from pulp decomposition in Johnson's "Text-book of Operative Dentistry" and in various dental journals.

not the tooth can be successfully bleached depends largely upon the cause of the discoloration, the condition of the tooth-structure, and the length of time the tooth has been discolored. Experience will prove that the teeth which will permanently retain their color, after it is restored, are those that have a good bulk of dentin and which dentin can be protected by the remaining enamel and some filling material, preferably porcelain if this material is at all indicated. I desire to emphasize the fact that it is folly to expect a tooth to retain its color any length of time after once being bleached, unless *the dentin is properly protected.*

Having ascertained the cause of the discoloration and believing that the condition of the tooth-structure justifies us in attempting to bleach the tooth, we come to the most important consideration, viz., the selection of the bleaching agent, with which the color can be restored with the least inconvenience to the patient and operator.

METHODS OF BLEACHING.

All of the methods employed in bleaching teeth involve more or less chemistry and from a chemic viewpoint there are two general methods of bleaching teeth—*oxidation* and *reduction.*

I. **Oxidation.**—This general method is of two kinds, also, *direct* and *indirect.*

1. *Direct.*—By direct oxidation is meant the use of any agent or agents from which oxygen can be directly obtained. The agents used for the purpose are:

Sodium dioxid, Na_2O_2.

Twenty-five per cent. ethereal solution of hydrogen dioxid, H_2O_2.

Alphozone, $(COOH.CH_2.CH_2CO)_2O_2$.

Acetozone, $C_6H_5CO.O.O.COCH_3$.

Aluminum chlorid, Al_2Cl_6, and a three per cent. aqueous solution of hydrogen dioxid.

Oxalic acid, $H_2C_2O_4$.

2. *Indirect.*—By indirect oxidation is meant the use of any agent or agents by which oxygen can be obtained indirectly. The agents employed are such as will liberate nascent chlorin, Cl, a chemically active gas, which, in the presence of moisture, seizes upon a molecule of water, H_2O, abstracts the atoms of hydrogen, H, forming hydrochloric acid, HCl, and liberates the oxygen, O, in the nascent state, as $H_2O + 2Cl = 2HCl + O$ (nascent).

Some of the agents used for this purpose are:

Aluminum chlorid and a freshly prepared Labarraque's solution (Harlan).

Chlorinated lime and dilute acetic acid (Truman).

Powdered alum, $Al_2K_2(SO_4)_4$, and Labarraque's solution.

Solution of sodium chlorid electrically decomposed.

II. **Reduction.**—By reduction is meant the use of any agent or agents which will abstract oxygen from a compound containing it. The agents which have been recommended are, sodium sulphite, Na_2SO_3, 10 parts, and boric acid, H_3BO_3, 7 parts. These are mixed and placed within the tooth, moistened with water and hermetically sealed (Kirk). A reaction occurs between the two substances, with the ultimate formation of sulphurous acid which has a great affinity for oxygen and is therefore a good reducing agent. In some cases where the tooth has been discolored by remedial agents, and where it is desired to break up the color molecule, good results are obtained by this method. Whenever the method is used, the tooth should subsequently be thoroughly washed with an alkaline solution, such as a 10 per cent. solution of sodium bicarbonate or borax, to neutralize the acid.

In most cases of discoloration, the direct oxidation method is preferable; and, in view of the fact that all of the agents used in the indirect method of bleaching depend upon the generation of oxygen for their efficacy, it can readily be understood that the direct method is far more satisfactory. The fact, also, that hydrochloric acid is a constant by-product in the indirect method, thereby creating an *acid* medium, adds to the objectionable features of this method; for manufacturers have recognized for years that better results can be obtained in bleaching ivory, wool, hair, feathers, etc., when the bleaching process is carried on in an *alkaline* medium. This is likewise true in bleaching teeth. Believing, then, that the direct oxidation method is far superior to the indirect, I shall not burden my readers by describing the latter method, but will direct attention to the detailed use of sodium dioxid and 25 per cent. ethereal solution of hydrogen dioxid—both direct oxidizing agents, and which, if their chemic properties are known and their dental application understood, the author believes to be the best agents for bleaching teeth thus far suggested to the profession.

Using Sodium Dioxid.—Sodium dioxid occurs in commerce as a yellow powder and is readily decomposed by water into caustic soda and oxygen. Because of this latter fact, much of the product obtained from

wholesale druggists labeled "sodium dioxid," is nothing but caustic soda. This accounts for the fact that many dentists have tried this method of bleaching and failed to get results. The fault is not with the method, but with the powder used. In order that we might be able to ascertain the efficacy of the chemical, some years ago I devised a simple chemic test for this purpose. In a clean, dry test-tube place about 15 gr. (1.0 gm.) of the powder and to it add 30 min. (2.0 c.c.) of water. If the specimen is good sodium dioxid, enough oxygen should be generated to kindle a glowing splinter held at the mouth of the tube. Having tested the chemical and proved it to be sodium dioxid, and not caustic soda, the next thing is to properly prepare the tooth, which, of course, should have been previously treated and the root filled with white gutta-percha.

Preparation of the Tooth.—The rubber dam should be adjusted, if possible, without the use of the steel clamp. The ligature should be wrapped twice around each tooth included in the dam, which should be at least two teeth on either side of the one to be bleached. This will prevent the by-product, caustic soda, from getting on the soft tissue and destroying it. The lower third of the root filling should now be removed with a good-sized round bur—it being necessary, for permanent results, to bleach the tooth rootwise as far as possible. We are now ready to apply our bleaching agent.

Making the Application.—Both the dry sodium dioxid and a solution made by carefully dusting the powder into ice-water is recommended to be used. The best results are obtained by using the dry powder, placing it into the cavity and, with a platinum broach or pointed glass instrument, work the powder well up into the canal from which the root filling has been removed. Care should be taken not to use steel instruments, as oxygen will attack the steel, forming ferric oxid, and therefore we may get into the tooth the pigment we are trying to remove. In some cases it is rather difficult to place the powder in the cavity without getting it on the patient's face or clothing. To overcome this a strip of unannealed 1:1,000 platinum foil can be placed between the discolored and adjacent tooth, letting it extend above or below the cutting-edge, as the case may be, when white base plate gutta-percha can be warmed and pressed against the lingual surfaces of the teeth included in the dam. This forms a pocket on the labial side into which the powder can be easily placed, using a little gold or platinum spoon or spatula. In more difficult cases a paste can be made of the powder and chloroform, in which it is insoluble, quickly packing the paste into the cavity, evaporating the chloroform,

leaving the dry powder where it is desired. Distilled water is now dropped upon the powder, causing a lively effervescence, and the following reaction takes place:

$$Na_2O_2 + H_2O = 2NaOH + O \text{ (}\textit{nascent}\text{)}.$$

This nascent oxygen is a powerful oxidizing agent. It attacks and rapidly destroys any organic matter which may be present in the tubular structure of the dentin. It also thoroughly bleaches vegetable colors and acts upon any iron compounds which may have produced the discoloration. It converts ferric hydroxid, if present, into ferric oxid—still an insoluble compound. If ferrous sulphid is present in the moist state, it may be converted into ferrous sulphate, a soluble salt; but in the presence of caustic soda it would be reprecipitated as ferrous hydroxid, which, in turn, in the presence of oxygen, is at once reconverted into ferric oxid. Therefore, the pigment to be removed, if our chemic reasoning is correct as to the cause of the discoloration from pulp decomposition, is ferric oxid, an insoluble compound, and must be removed mechanically by washing the tooth. Its removal is facilitated by the by-product, caustic soda, acting upon any fatty substances—fat being an end-product of the putrefaction of the proteid material—which may be present in the tubuli. The result of this action being a soluble soap, the removal of which by washing, aids, as stated, the mechanical removal of the insoluble pigment.

It is the opinion of the author that the ultimate success depends quite as much upon the mechanical removal of the coloring matter as upon the chemic destruction of it; therefore, the necessity for thoroughly washing the tooth after each application of the bleaching agent. Warm distilled water should be used in a strong syringe, letting a moist sponge absorb the water. The cavity is now dried, the color of the tooth observed and the process repeated, if necessary. Usually two or three applications are sufficient. If the color is not readily restored, the dentin can be saturated with a 2 per cent. solution of sulphuric acid which can now enter the tubuli and chemically convert the oxids, that may not have been mechanically or otherwise removed by the saponifying and washing process, into sulphates. The salts produced are freely soluble, and can readily be washed out by again using the warm water.

Final Treatment.—When the tooth is satisfactorily bleached, a paste of precipitated calcium phosphate and distilled water can be placed in the cavity, packed into the lower third of the root and burnished, with a warm burnisher, against all exposed dentin. This

is thoroughly dried by burnishing, the excess removed, and a light-colored, quick-setting cement used to form a base for the final filling.

Using 25 per cent. Ethereal Solution of Hydrogen Dioxid.—A 25 per cent. ethereal solution of hydrogen dioxid, called also caustic pyrozone, can be obtained in specially prepared and hermetically sealed glass tubes. The date of its preparation is stamped upon the tube to guarantee its activity, for its value as a bleaching agent depends upon the volume of nascent oxygen which is liberated. It is therefore important that a good specimen of the agent be obtained. Care must be exercised in opening the tube, which should be wrapped in a cold, wet towel and held firmly in the left hand. With a *sharp* file make a groove around the pointed end of the tube, after which this end may be easily broken with a pair of pliers, pointing the tube away from the face. A sharp file should be used as a dull one might produce a spark and cause an explosion. When the tube is opened the contents should be transferred at once to a clean glass-stoppered bottle. The stopper should be sealed with paraffin when the remedy is not being used. In making the transfer, care should be taken to keep the agent from coming in contact with the fingers, as it readily cauterizes soft tissue.

Preparation of the Tooth.—The tooth should be prepared exactly as in using sodium dioxid, except the cavity of the tooth should be moistened with an alkaline solution (10 per cent. solution of borax or sodium bicarbonate) before making the application. This is done in recognition of the fact that the bleaching process is more successful if carried on in an alkaline medium.

Making the Application.—There are some cavities into which it is difficult to place sodium dioxid, even if a paste has been made with chloroform on account of the rapid evaporation of the latter. This is especially true where the cavity is small and in the lingual surface of one of the six upper anterior teeth. Teeth containing such cavities can usually be bleached more conveniently by using caustic pyrozone. The remedy can be applied in the canal loosely on cotton. To hasten the liberation of oxygen, a heated platinum wire can be gently placed on the cotton. The wire should not be too hot, as the heat may cause a flame from the ether in the solution. Heated dry air may also be used for the same purpose. After each application the tooth structure should be thoroughly washed with a warm alkaline solution, and the process repeated until the color is satisfactorily restored.

If after repeating the application two or three times, the tooth is not satisfactorily bleached, the solution may be hermetically sealed in the cavity. If the cavity is small and on the lingual surface,

the sealing can best be done by the use of gutta-percha (not temporary stopping). The excess of solution can be dried from the cavity and the hot gutta-percha applied, the heat of which hastens the liberation of oxygen which, together with the expansion of the confined ether, is carried into the entire tubular structure of the dentin. It is well to have the gutta-percha just flush with the margins of the cavity and then cover with cement. By this means we are doubly certain that the remedy cannot escape. The final treatment is exactly the same as in using sodium dioxid.

Caustic pyrozone is a very escharotic agent, and equally as much care should be taken to prevent the remedy from coming in contact with the soft tissues of the mouth or the fingers of the operator, as in using sodium dioxid. The remedy being in liquid form is more easily handled than the sodium dioxid powder.

The other direct oxidizing agents are used in practically the same way. The alphozone and acetozone powder can be placed in the cavity, moistened with an alkaline solution and hermetically sealed. The volume of oxygen liberated from these agents is not great, and the process of bleaching, therefore, is much slower than when sodium dioxid or caustic pyrozone is used.

In conclusion, I desire to say that in the bleaching of teeth we find a practical application of the science of chemistry to the practice of dentistry, and that in the discoloration of tooth-structure from the various sources can be found a fruitful field for further investigation.

ANTRUM OF HIGHMORE.

GENERAL CONSIDERATIONS.

The antrum of Highmore, or maxillary antrum, is a chamber or cavity in the body of the superior maxillary bone on either side of the jaw. It should be remembered in connection with the therapeutics of the diseases of the antrum that the cavity is normally lined with mucous membrane, which is continuous from the nasal cavity through a small opening, called the ostium maxillare; and that the cavity varies in location and size, capable of containing from two drams (8.0 c.c.) to sometimes one ounce (30.0 c.c.) of fluid. Fortunately, the dentist, in general practice, is not often called upon to treat diseases of the maxillary antrum, but when a case presents of purely dental origin, he should be prepared to make a correct diagnosis and to properly treat the case.

Causes of Diseases of the Antrum.—There are many contributing causes of diseases of the maxillary antrum, among the more important of which are:

1. *Dental Conditions.*—It is quite generally conceded by both rhinologists and dentists that the teeth, or conditions associated with the teeth, are the greatest source from which the membrane lining the chamber may become irritated to the extent of bringing about a degeneration of the cells, when infection is liable to occur and pus result. It has been previously mentioned that one of the serious complications of alveolar abscesses was where the pus became evacuated into the antral cavity, rather than working its way through the labial or buccal, and sometimes through the lingual plate of bone emptying into the mouth, as is the case usually. The author reports here two cases in the college infirmary where the student had removed a vital pulp and entered the antrum through the canal, showing that all that separated the end of the root from the floor of the antrum was the mucoperiosteum, which the student penetrated. One case was the lingual canal of a first molar, and the other the canal of a second bicuspid. If abscesses occur in connection with teeth thus situated in the jaw, the antrum would at once become involved.

2. *Catarrhal Inflammation.*—Since the Schneiderian membrane which lines the nasal cavity passes through the ostium maxillare and the

continuation of it lines the antral cavity, any inflammation of the nasal mucous membrane, if continuous and progressive, may involve the antrum. Especially is this true with patients having catarrh, influenza, or grip. Even an acute coryza may seriously involve the antrum.

3. *Foreign Material.*—Foreign material constitutes another prolific source of disease of the antrum. Teeth, especially third molars, have been known to erupt into the antrum; dentigerous cysts and polypi are frequently found; and, occasionally, in the careless extraction of a pointed root, and even at times when due care and judgment is exercised, if the root is badly decayed, it may be forced by the forceps into the antral cavity.

4. *Traumatism.*—The antrum frequently becomes involved as a result of some traumatic injury, such as a blow, etc.

It is frequently difficult to make a correct and positive diagnosis of antral disease. The symptoms generally are of the subjective

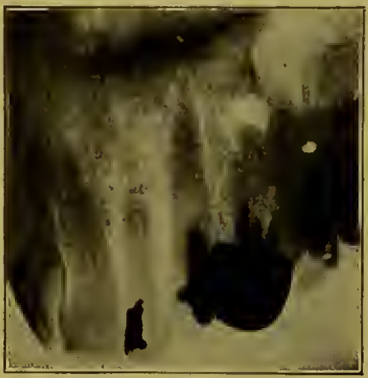

FIG. 35.—This skiagraph, taken by Ream, shows a case of suspected antral involvement. There was no external discharge of pus, but severe neuralgia and some of the other subjective symptoms of antral disease. The cuspid and first bicuspid, on the affected side, carried artificial crowns. The skiagraph indicates that the antrum is not involved; but shows that the canal of the cuspid root is not filled, which was found to be putrescent; and a necrotic area about the apical end of the first bicuspid.

variety, unless the cause is some traumatic injury, in which case the diagnosis is readily made. The symptoms which aid in arriving at a diagnosis are: A sense of fullness on the affected side, at times the pressure may be so great as to cause the eye to distend from its orbit; frequently an odor and discharge of bloody pus or mucus through the nose, especially when the patient coughs or sneezes, or when he lies in a certain position. The use of the X-ray and the little electric mouth-lamp, while by no means positive, are invaluable aids in making the diagnosis (see Fig. 35). By pulling down the shades and making the room as dark as possible, and placing the electric mouth-lamp on the lingual side of the teeth a dead pulp may be detected which is

causing the trouble. Placing the lamp higher in the vault, the antrum, if diseased, will generally present a more cloudy or foggy appearance than will the healthy antrum. After making the diagnosis, the next important step is to decide on the method of treatment. If no dental condition seems to be causing the disease, the patient should be referred to a rhinologist for further examination; but if the diseased condition of the antrum is of dental origin, it is the prerogative of the dentist to treat the case, if he so desires.

THERAPEUTICS.

The treatment is of two kinds—*surgical* and *medicinal.*

1. **Surgical Treatment.**—The surgical treatment of diseases of the antrum will be discussed here but briefly. To intelligently treat the condition it is, of course, essential to find the cause and remove it. Let it be understood that this does not necessarily mean that if the cause of the antral trouble is an abscessed tooth, it is necessary to extract the tooth. Frequently, by treating the affected tooth and opening into the antrum and washing out the cavity, the case will yield nicely. Whether it is necessary to extract the offending tooth is often a difficult problem to solve. Many teeth have been needlessly sacrificed in the surgical treatment of diseases of the maxillary antrum, especially by the general surgeon; while, on the other hand, many antrums have become chronically diseased, which condition might have been avoided and the case cured during its incipiency, had it not been for the presumed conservativeness of dentists especially, in their efforts to cure the antral disease and at the same time save the tooth. It should be remembered that *important as every tooth is—a healthy antrum is of greater importance.* In making this statement the author does not mean to encourage the needless extraction of teeth in connection with the surgical treatment.

The site of making the opening depends upon the conditions as found. Probably no two cases will need exactly the same kind of opening. It may be made through a tooth-socket, just posterior to the canine fossa, between the roots of teeth, or through the nose. The latter opening should be made by a rhinologist, if necessary. The tendency at first is to make the opening too small rather than large enough. In many cases it is necessary to have the opening sufficiently large to make an ocular or digital examination. A thorough examination at this stage of the operation will determine whether the cavity needs curettement or simply the establishment of drainage and evacuation of the pus or mucoserous fluid.

It is seldom necessary to administer a general anesthetic other than nitrous oxid and oxygen for the purpose of opening into the antrum painlessly. It may be accomplished in most cases practically without pain by the use of local anesthetics. With the soft tissues anesthetized there is little pain produced in drilling through the bone. Where curettement is indicated, a general anesthetic had better be given. Nitrous oxid and oxygen serves the purpose admirably. We now come to the phase of the subject of most interest from *our* point of view—the *therapeutics*. Before discussing the drugs used in treating diseases of the antrum of Highmore, I desire to emphasize the fact that it matters little what drugs are used as long as they are practically nonirritating and antiseptic, if the surgical treatment has been all that is required. If the cause has not been surgically removed or corrected, drugs will be of little avail; for this reason the surgical treatment has been discussed here briefly.

2. **Medicinal Treatment.**—The therapeutics of the condition under consideration consists in washing the antral cavity with bland remedies for the purpose of disposing of the pus and mucoserous fluid; this to be followed by antiseptic and stimulating remedies. Any bland solution may be used which is nonirritating and antiseptic, providing the odor and taste of the agent employed is not objectionable. A warm saturated solution of boric acid serves the purpose admirably. The author, however, prefers using a warm sterile normal salt solution. These solutions may be used in a fountain syringe, having the latter placed on the wall as high as convenient so that considerable force may be exerted in the washing process. A glass or hard rubber point should be attached to the rubber tubing, and should be of such shape and size as to pass easily into the opening. The escape of fluid from the syringe should be controlled by a stop-cock. By this means the cavity can be well flushed out, using a considerable quantity of fluid. In the absence of a fountain syringe, a strong water syringe may be used. The normal saline solution also acts as a stimulant to the mucous membrane. After thoroughly washing the cavity, most of the solution which naturally remains can be absorbed with cotton and the cavity injected full of some antiseptic and stimulating remedy. Brophy recommends argyrol, using all the way from a 10 to a 50 per cent. solution.

Beck suggests using bismuth paste. This has the distinct advantage of completely filling the space with a semi-solid, oleaginous paste, which guards against septic invasion from the mouth, and at the same time holds the stimulating drug in contact with the entire membrane of the cavity. Some care must be exercised in making the injec-

tion so as not to force the paste into communicating sinuses. The injection may be repeated as often as the necessity of the case demands. If there be no complication, two or three injections, at intervals of two or three days, will generally suffice.

There is little necessity for using strong disinfectant or cauterizing agents in the medicinal treatment of diseases of the maxillary antrum. If the case does not yield to the treatment here given, some complication may be expected, for which see works on Oral Surgery.

PYORRHEA ALVEOLARIS.

GENERAL CONSIDERATIONS.

Because of the customary use of the term, and for want of a better one, this much-named disease has been called, throughout this work, *pyorrhea alveolaris.* The true pathology and etiology of this disease is yet an unsolved problem, notwithstanding the fact that its solution has been attempted by the most scientific men of the profession. Whether the disease is of purely local origin or is a local manifestation of some constitutional disorder will not be discussed here. The author is of the opinion that a mistake has been made by the profession generally in grouping all of the disorders commonly called pyorrhea alveolaris under one heading and endeavoring to effect a cure of the entire group by a common treatment. It is true that the treatment of the various diseases affecting the gum, pericemental, and alveolar tissues have many things in common, yet the correct treatment must necessarily involve special measures to meet the demands of a given case. Therefore, for convenience in outlining our treatment the various disorders so commonly grouped under the heading of pyorrhea alveolaris will be arbitrarily divided into three classes. It must be understood, however, that in reality no distinct line of demarcation can be drawn. The division is made purely for convenience in studying the disease from the therapeutic point of view.

DESCRIPTION OF CLASSES.

Class I.—This class includes such cases as often present where upon examination it will be noticed that around several teeth in the mouth, just under the free margin of the gum, there is a hard, dark, flint-like, annular deposit, which in some instances nearly and oftentimes completely encircles the tooth. This deposit comes from the blood, and is known as *serumal calculus.* It is caused by some local irritant at the gum margin, generally oral filth and bacteria, which results in gingivitis—always a characteristic symptom of this class. There may or may not be pus, generally there is not; the pockets, if any, are shallow. It will usually be noticed that there is more or less *salivary deposits* also on the lingual surfaces of the lower anterior teeth

and on the buccal surfaces of the upper first and second molars. The general condition of the mouth shows every evidence of neglect, which may be considered the cause of this class of pyorrhea alveolaris. Fig. 36 shows the extent to which salivary deposits may accumulate in a neglected mouth.

Class II.—This class is what might properly be called true pyorrhea alveolaris. In it will be considered those aggravated cases wherein there is no evidence of gingivitis; the gum, in fact, is anemic rather than hyperemic, and is gradually receding from the neck of the tooth. The pericemental membrane is being rapidly destroyed; the alveolar process is resorbed—virtually melting away; the pockets are

Fig. 36.—This shows the extent to which salivary calculus will form on the roots of the lower anterior teeth in some mouths, if neglected. The crown is nearly covered as is also most of the root—only a small portion near the apex being free from deposit.

deep and variously located around the single root of a tooth, and oftentimes between the roots of multi-rooted teeth. Pus is generally present, and there may or may not be hard deposits. Unless the disease is checked, there is a progressive loosening of the teeth, to the extent that they ultimately drop out. The cause of this class is unknown. It may be a bacterium, but as yet no specific germ has been satisfactorily demonstrated to be the exciting agent, though the presence of various pathogenic germs have been scientifically proven, as is evidenced also clinically by the pus formation. Surely the cause cannot be neglect on the part of the patient, for the disease occurs and often persists in the mouths of patients who are scrupulously clean so far as the toilet of the mouth is concerned. The cause in far too many instances can rather be traced to neglect on the part of the family dentist, who either failed to recognize and correct the disease in its incipiency, or, recognizing it, informed the patient that nothing could be done and advised letting it go, and ultimately extracting the teeth. It is sadly to be regretted that so many teeth have been needlessly lost in the past

because of the seeming indifference of dentists; but the wave of prophylaxis that is floating over the profession to-day, due to the efforts of D. D. Smith and others, is an encouraging sign that individual dentists are either equipping themselves to combat the disease or are referring the patients thus afflicted to dentists who are so equipped. Fig. 37 illustrates a typical case of this class.

Class III.—In this class will be considered those cases in which we are reasonably certain that the local condition in the mouth is at least aggravated if not entirely due to some systemic derangement. It has been quite clearly demonstrated by Pierce, Rhein, Talbot, Kirk, Fletcher, Endleman, and others that at least certain kinds of pyorrhea alveolaris is closely associated with, if not caused by, such general diseases

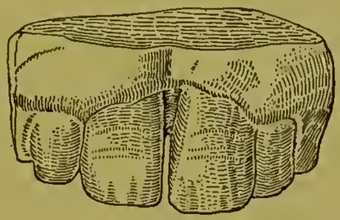

Fig 37.—This shows the recession of gum tissue due to the resorption of the alveolar process between the central incisors—the result of pyorrhea alveolaris.

and conditions as syphilis, tuberculosis, actinomycosis, diabetes, gout, rheumatism, osteomyelitis, salivation, phosphor poisoning, and faulty metabolism in general. The symptoms here are variable, and depend largely upon the general complication. In such diseases as syphilis, tuberculosis, actinomycosis, and osteomyelitis, the alveolar process is extensively involved and usually rapidly resorbed, the teeth are loosened, there is generally an absence of hard deposits, the pus is persistent, and recovery is much slower than usual. In diabetes the gums are often turgid and raw, the pericemental membrane is inflamed and highly sensitive, there is a tendency toward the formation of serumal deposits, and pus may or may not be present. In gout or rheumatism there is more or less neuralgia, serumal deposits are generally present and attached to the tooth nearer the apex of the root than is the case ordinarily. The mouth symptoms of salivation or mercurial stomatitis and phosphor poisoning have been elsewhere described. In faulty metabolism the symptoms are variable, none of which have been demonstrated to be truly characteristic of the general condition. With this understanding of the conditions which present in the various classes of the disease under consideration, we will now discuss the treatment.

THERAPEUTICS.

When cases of pyorrhea alveolaris present for treatment, the first important consideration is to impress upon the mind of the patients the fact that you must have their hearty cooperation, and that in order to obtain permanent results it will be necessary for them to follow your instructions closely. There is perhaps no condition which dentists are called upon to treat wherein the confidence, and especially the cooperation of the patient is of such vital importance, so far as permanent results are concerned, as in the treatment of true pyorrhea alveolaris; and it is truly surprising what good results can be accomplished by the conscientious and persistent efforts of both dentist and patient.

Before undertaking the treatment of a case, then, there should be a distinct understanding as to what may reasonably be expected. The discerning patients naturally will want to know at the outset if their cases can be *cured*. The word "cure" here is but a relative term, and an explanation should be made in regard to what a so-called cure includes. It does not mean that the lost tissues—gum, pericemental, and alveolar—can be restored. It should mean, however, that the teeth treated can ultimately be made healthy, comfortable, and useful, so far as mastication is concerned. Any tooth which cannot be reasonably expected to be restored to this condition had better be considered a hopeless tooth and extracted at once, and there are many such in the mouths of pyorrheal patients.

While the presence of pus, which is constantly being mixed and swallowed with the saliva and food, is of greater importance, so far as health is concerned, than is the looseness of the teeth in the jaw, patients, as a rule, are more interested in the latter phase of the question; and they are always anxious to know whether the now loosened teeth will become firmly fixed in the jaw after the treatment. This all depends upon the case at hand and the mechanical treatment involved. In the past too much dependence has been placed in drugs, and too much also has been left to Nature to tighten the teeth, when such should not be expected on account of the extensive loss of tissues; and the conscientious dentist who makes extravagant statements in this respect will cause much disappointment to both himself and to the patient. It is surprising, at times, how loosened pyorrheal teeth will tighten in the jaw under proper treatment without mechanical assistance, but too much should not be promised in this respect. The author desires to speak plainly on this point, for herein often lies the greatest source of dis-

appointment. Unless the end of the root is resorbed, leaving it roughened, the pus formation can be checked, the gum can be made to resume a healthy appearance, but many times the teeth, without mechanical aid, will not materially tighten, though otherwise they are perfectly healthy and comfortable. Their usefulness, of course, is impaired on account of their being loose. Fig. 38 illustrates a typical case of class II in the author's practice, where the two loosened bicuspid teeth were cured of the pyorrheal trouble and made healthy and useful only by virtue of being permanently fastened to the solid molar and cuspid tooth on either side.

FIG. 38.—In this case a series of inlays were made and soldered together; then the appliance was cemented to place, binding the four teeth firmly.

A thorough understanding at the beginning of the treatment, then, serves as a means of stimulating *confidence* on the part of the patient in the operator's ability to meet the conditions as found and the conscientiousness with which he works. No dentist should undertake the treatment of a case of true pyorrhea alveolaris unless he is equipped to render the best possible service, considering always the personal equation, and then only with the understanding that both he and the patient are to work in harmony—each exerting their best efforts to eradicate the disease. It is far better not to undertake the treatment of a case than to have it end in disappointment.

The detailed treatment of the three classes into which the disorders commonly called pyorrhea alveolaris have been divided will be considered separately, for herein lies the value of making the subdivisions. The treatment is of three kinds—*surgical*, *medicinal*, and *mechanical*.

CLASS I.

1. **Surgical Treatment.**—In this class, it will be remembered, deposits are always in evidence. The first step in the treatment is to *remove the deposits*. This is accomplished by instrumentation, care

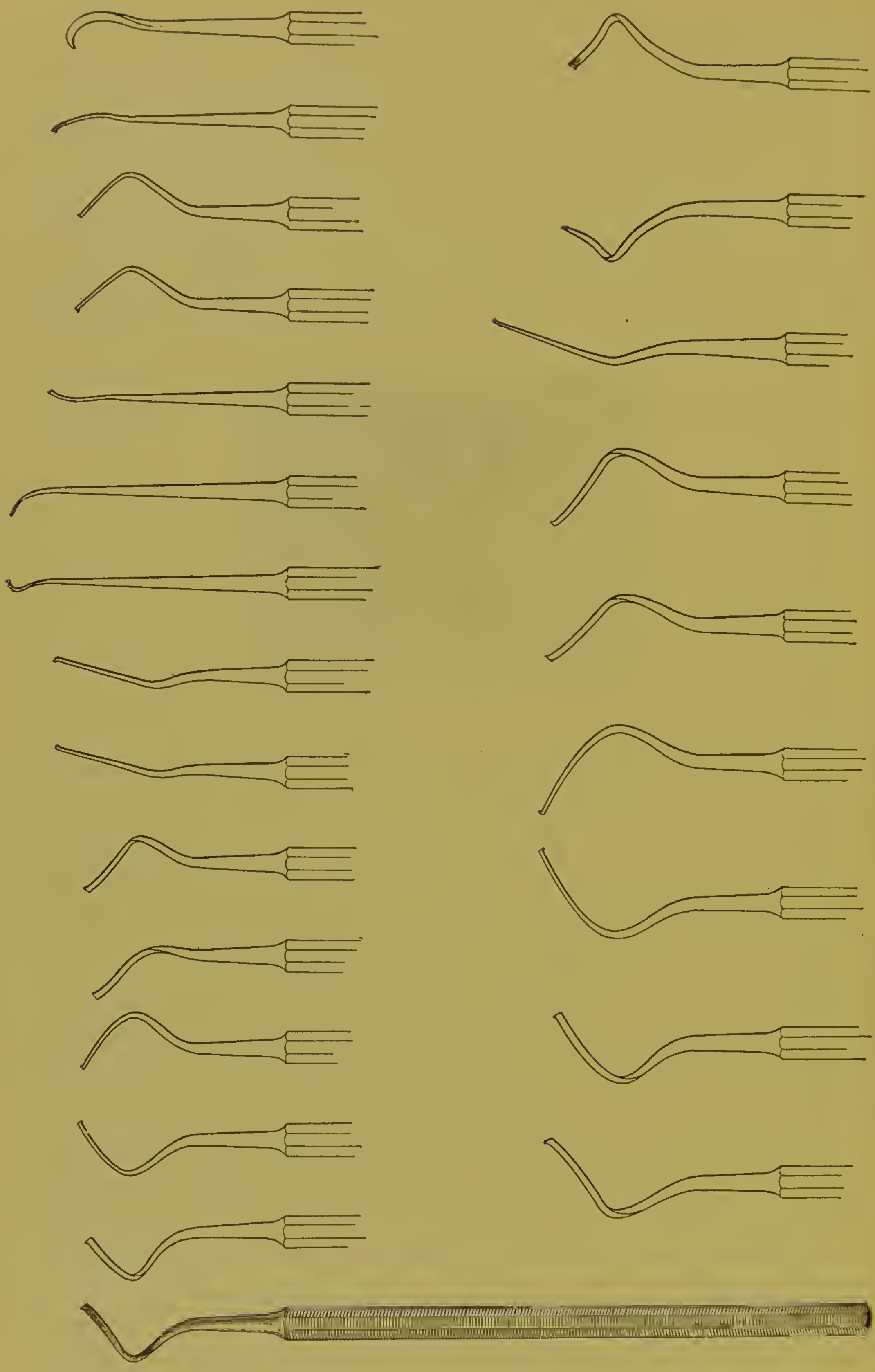

Fig. 39.—Logan-Buckley Set of Pyorrhea and Prophylactic Instruments. For description of their uses, see next page.

being taken to remove the irritant material without undue injury to gum, pericemental, and tooth-structures. The instruments which the author uses for this purpose are the Logan-Buckley set, illustrations and brief descriptions of which are found in Fig. 39. Another very excellent set of instruments is known as the Carr set. By the use of either of these sets of instruments the deposits can be removed with a minimum amount of injury to the structures involved. Mawhinney has especially emphasized the injury done to the so-called dental ligament and the other soft tissues by careless instrumentation, and Patterson, James, Hartzell, and others have demonstrated the fact that better results are obtained when the deposits are removed in such a manner as to leave the tooth-surface smooth and easily polished.

Before beginning the scaling process the mouth should be thoroughly sprayed or rinsed with an antiseptic solution. For this purpose the author uses cinnamon water to which about 2 per cent. of alcohol is added. The cinnamon water is an agreeable solution, and the alcohol aids in removing the mucoid material with which the teeth in this class of cases are generally coated. A glassful of the cinnamon water should also be in a convenient place. This solution can be colored pink or a reddish tinge by adding a small amount of tincture of cudbear. The object in having the solution colored is to prevent the patient from seeing the blood which is always more or less in evidence in scaling these teeth on occount of the gingivitis—a characteristic symptom of this class. The solution is used with a strong

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BRIEF DESCRIPTION OF THEIR USES.

These instruments are so designed that the teeth may be scaled systematically. Beginning on the mesiobuccal surface of an upper molar or bicuspid tooth, the instruments are used as follows: No. 1 for the mesiobuccal, No. 2 for the buccal, No. 3 for the distobuccal, No. 4 for the distolingual, No. 5 for the lingual, and No. 6 for the mesiolingual surfaces. These six instruments, therefore, scale systematically around the tooth. If at any point a pocket is found too deep to be reached with these instruments, their counterparts, except with a narrower point and exaggerated in form, are found in Nos. 16 to 21 inclusive. For example, No. 16 is the exaggerated form of No. 1, and so on with the entire six instruments. For the lower teeth the positions of the instruments are exactly reversed, *i.e.*, Nos. 1 and 16 are here used on the mesiolingual surface, etc. With one or the other of these groups of six instruments the molar and bicuspid teeth can be scaled, except occasionally where deep pockets are found between the roots of molar teeth and on the lingual surface of the divergent lingual root of upper molars. For these exceptional cases, Nos. 9 and 10 are right and left and are employed for scaling between the roots of molars, and Nos. 24 and 25 are right and left for the lingual surface of a divergent lingual root of upper molars. No. 23 is for the distal surfaces of posterior teeth (third molars).

For the anterior teeth, upper and lower, No. 7 is designed for the lingual surfaces, and No. 8 for the labial. In cases where there is a deep lingual pocket which cannot be reached with No. 7, No. 22, the exaggerated form, can be used. No. 11 is a push instrument used in removing deposit from between crowded and irregular teeth. No. 15 is a general hook for removing the bulky deposit before the more delicate instruments are used. Nos. 12, 13, and 14 are prophylactic instruments which can be used with either a push or pull movement and will be found useful in removing superficial decay and in smoothing and polishing rough surfaces.

water syringe as often as is necessary to clear the field of operation. The scaling should be begun on some certain tooth in the mouth and this should not be left until it is thoroughly scaled. This can only be done with any degree of certainly by following some definite system. By using either of the sets of instruments mentioned, the scaling can be done systematically. With the L.-B. set, the author begins on the mesiobuccal surface of the upper third molar, and with the six instruments designed for the purpose one can work completely around the tooth in an intelligent manner. From here we can proceed from one tooth to another around the arch, using the instruments designed for the various surfaces. If there be a bulky deposit, such, for instance, as salivary deposits, this should be removed first with the hook instrument designed especially for this purpose.

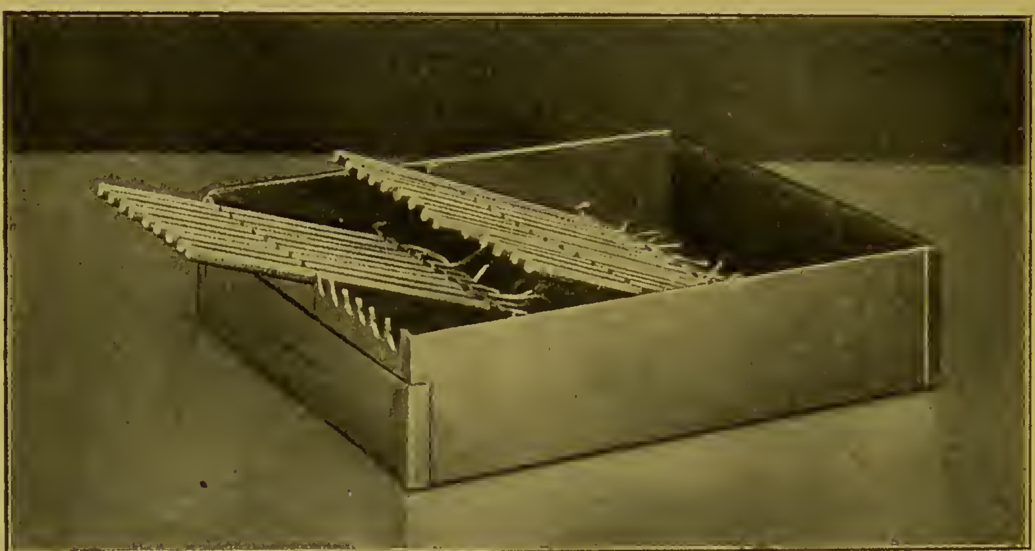

FIG. 40.—This shows the instruments in their proper places in the tray ready for use.

After an instrument has been used the point at least should be kept immersed in an antiseptic solution during the entire time the scaling is being done. This can best be done by having a tray which is designed to hold the instruments in their proper place. Such a tray with the entire L.-B. set of instruments in their proper places is illustrated in Figs. 40 and 41.

The instruments are presumed to be sterile before they are used, it is therefore unnecessary to have a strong disinfecting solution in the tray. Such a solution would either act upon the instruments or taste badly when the instrument is placed in the patient's mouth, for the necessary instrument should be taken directly from the rack of the tray and used in the mouth. A pleasant antiseptic solution, therefore,

should be in the tray. It is a principle in surgery to avoid the presence of germs by having the instruments sterile before using rather than to endeavor to kill the germ by the use of strong disfectants during the operation. The author uses a 20 per cent. solution of phenol compound in glycerin, and of this about 10 min. (0.6 c.c.) is added to about 1/2 pint (240.0 c.c.) of sterile water, which is in the tray. This solution can also be colored with tincture of cubbear to conceal the blood.

The pockets here, if any, are not deep; the deposits are readily removed, and a number of teeth may be scaled at once sitting. Unless there be some good reason for extending the length of time of the operation, it should be limited to one hour, and the scaling process should be stopped in sufficient time to permit a thorough prophylactic

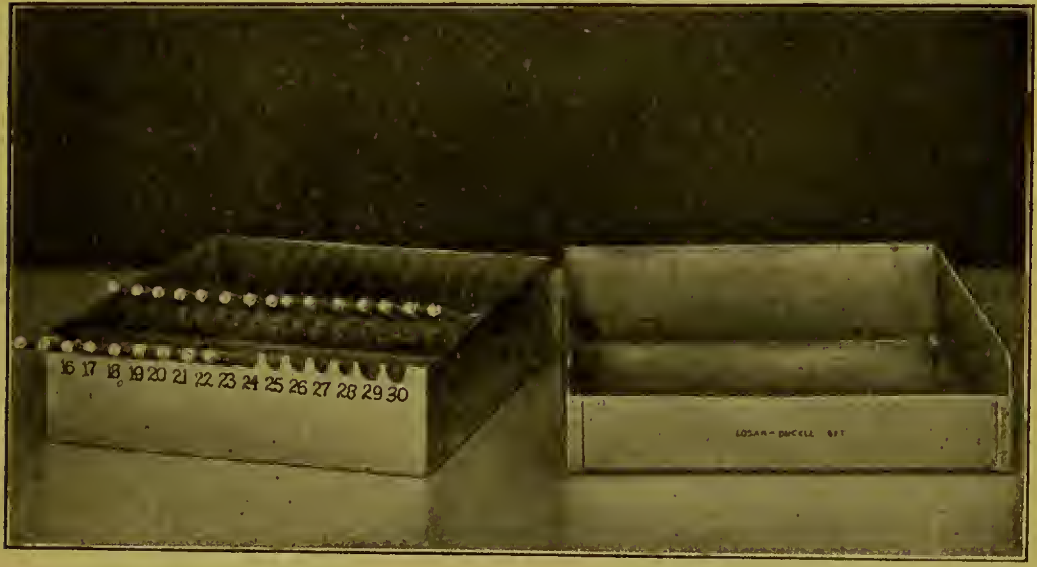

FIG. 41.—This shows how the inner rack can be removed for the purpose of sterilization.

treatment with orange wood, pumice, and tape, according to the method of D. D. Smith, before applying the medicinal treatment. The teeth here are not loose and, therefore, they need no mechanical support. A record should be kept of the teeth treated at each sitting, so that we may know exactly where to begin when the patient returns.

2. **Medicinal Treatment.**—After the teeth have been thoroughly scaled and polished, the mouth should again be thoroughly sprayed with the antiseptic solution, forcing it well between the teeth and around the gum margins to mechanically remove any loose deposit, and pumice which may be left from the polishing. By the use of cottonoid rolls the parts treated can be kept dry and an application made of some astringent remedy. This can be worked with a glass

instrument under the free margin of the gum and over the gum septum, keeping the parts dry for a few moments, when the mouth can again be thoroughly sprayed and rinsed with the antiseptic solution. If the teeth are at all responsive to heat and cold, the solutions used should always be warmed to the temperature of the body. Spraying outfits are now on the market which keep the solutions warm; and, if the dentist devotes much time to pyorrheal or prophylactic treatment, these outfits should constitute a part of the office equipment. As a local astringent in these cases, the author suggests the following:

℞—Potassii iodidi,	ʒij (8.0 gm.)
Iodi (crys.),	ʒijss (10.0 gm.)
Zinci phenolsulphonatis,	ʒij (8.0 gm.)
Aquæ,	fʒvj (24.0 c c.)
Glycerini,	fʒiijss (14.0 c c.).—M.

Sig.—Use as directed above.

This remedy is called *pyorrhea astringent.*

The patients should now be instructed how to properly brush, massage, and care for their teeth generally, prescriptions should be written for a tooth-powder or paste and an antiseptic mouth-wash, and the patient dismissed until a second sitting. In giving the instruction relative to brushing the teeth and massaging the gums, it should be emphasized that the gums should be vigorously brushed as well as the teeth—thus we get the benefit of massage. Many hand and electrical appliances are also on the market for massaging the gums.

The above treatment, in practically every detail, should be repeated at each sitting until the mouth is in good condition, after which there will probably be little need for further medication. The patient should be requested to return at frequent intervals that the case may be watched, and each time the patient returns an examination should be made with respect to the care given the teeth. If all is well, the patients should be complimented, if not, they should be cautioned accordingly.

The general prescribing of mouth-washes containing highly astringent drugs, as the zinc salts, in the treatment of pyorrhea alveolaris, in the opinion of the author, is wrong. It is true that certain tissues of the mouth needs be *constringed* and *stimulated* to healthy activity, but surely the entire mucous membrane of the mouth does not need to be so treated. Cook has shown that the continuous use of astringent mouth-washes interferes for hours with the action of the ptyalin upon starchy foods. The astringent remedy should be applied by the dentist to the parts only in need of such treatment, and

an antiseptic mouth-wash, together with the proper brush, tooth-powder or paste, and other utensils for mouth toilet is all the patient should use. If the patient is to use an astringent remedy at all, the constringing agents should rather be a constituent of a tooth-paste than of a mouth-wash. A prescription for a tooth-paste follows:

℞—Calcii carbonatis ppt.,		℥iijss (112.0 gm.)
Saponis,		℥ss (16.0 gm.)
Sodii benzoatis,		ʒj (4.0 gm.)
Eucalyptolis,		
Olei menthæ piperitæ,	āā	m. x (0.6 c.c.)
Thymolis,		gr. iv (0.25 gm.)
Saccharini,		gr. iij (0.2 gm.)
Glycerini,	q. s. ad.	pasta.—M.

Sig.—Use as a tooth-paste.

As a mouth-wash any known antiseptic solution can be prescribed. It is as unnecessary as it is unwise for the dentist to prescribe the "cure-all" mouth-washes or those the constituents of which are to him unknown. The official mouth-wash (Liquor Antisepticus, U. S. P.) or Dobell's solution may be prescribed and diluted to suit the case. The formula for the official solution follows:

Boric Acid,	5 dr. (20.0 gm.)
Benzoic Acid,	15 gr. (1.0 gm.)
Thymol,	15 gr. (1.0 gm.)
Eucalyptol,	4 min. (0.25 c.c.)
Oil of Gaultheria,	4 min. (0.25 c.c.)
Oil of Peppermint,	8 min. (0.5 c.c.)
Oil of Thyme,	2 min. (0.1 c.c.)
Alcohol,	8 fl. oz. (240.0 c.c.)
Water, to make	1 qt. (1,000.0 c.c.)

In prescribing this solution it is never necessary to remember all of the various drugs and their quantities. We can take advantage of the fact that the solution is recognized by the United States Pharmacopeia and write its official title, as:

℞—Liquoris antiseptici, f℥viij (240. 0 c.c.)
Sig.—Dilute with one-half of warm water and use as an antiseptic mouth-wash.

It is well to remember, however, that the solution contains about 2 per cent. of boric acid, 0.1 per cent. of benzoic acid and thymol, 25 per cent. of alcohol, and other aromatics and antiseptics added to water as the vehicle. Herein is illustrated a practical application of a knowledge of the Pharmacopeia.

In those cases complicated by indigestion and where the patient

complains of a sour taste in the mouth, especially on rising in the morning, due either to local fermentation or to the regurgitation of acid from the stomach, the condition may be corrected by the following prescription:

℞—Sodii bicarbonatis, ʒj (4.0 gm.)
Infusi gentianæ comp., f℥iij (90.0 c.c.)—M.
Sig.—Take a tablespoonful before meals and on retiring.

Where the sour taste comes purely from fermentation in the mouth, all that is necessary is to have the patients use frequently a warm solution of sodium bicarbonate, or the following alkaline and antiseptic mouth-wash may be prescribed.

℞—Sodii bicarbonatis,
Sodii boratis, āā ʒss (2.0 gm.)
Thymolis,
Mentholis, āā gr. ss (0.03 gm.)
Alcoholis, fʒijss (10.0 c.c.)
Glycerini, fʒij (8.0 c.c.)
Aquæ cinnamomi, q. s. ad. f℥viij (240.0 c.c.)—M.
Sig.—Use wherever an alkaline and antiseptic mouth-wash is indicated.

CLASS II.

1. **Surgical Treatment.**—In this class of cases we are dealing with what may very properly be called true pyorrhea alveolaris, and in the surgical treatment it is especially necessary to use such instruments as will accomplish our end in a definite and certain manner. Here the exaggerated forms of the L.-B. set and those designed for scaling between the roots of molar teeth will be found extremely useful. If deposits are present, they *must be removed*, observing the same precautions as have been elsewhere mentioned. In the absence of deposits, the pockets, including both the affected tooth-surface and alveolar process, must be thoroughly curetted. We have here a more aggravated condition with which to deal, and from one to four teeth will doubtless be all that should be treated at one time, for the teeth thus operated upon are usually sore and more or less sensitive to thermal changes; therefore, the lesser number of teeth treated, the greater will be the comfort of the patient. The pockets are generally deep in this class of cases, and compressed air is an excellent agent to use for clearing the field and locating pockets.

Indications for the Removal of Pulps.—The question of removing the pulps from the affected teeth in this class of cases is an

important one. It may be safely stated that there are at least three indications for pulp removal, viz.: (1) where the pockets are deep and the infection in the apical area has left the pulp, if still alive, in a low state of vitality, (2) where it is necessary to adjust some mechanical appliance, and (3) where the tooth is so acutely sensitive as to be of constant annoyance to the patient. The latter condition may often be overcome, if a posterior tooth, by cauterizing the exposed cementum with silver nitrate (see p. 81) and the transitory sensitiveness following the scaling and polishing of the teeth may generally be reduced by polishing the surfaces with moist sodium bicarbonate, and having the patient rinse the mouth, especially before retiring, with a warm sodium bicarbonate solution.

It has been clinically observed by White, of Nashville, and others

Fig. 42.—This skiagraph, taken by Lewis, shows the result of an incorrect diagnosis. Pus was flowing from between the two central incisors and from between the left central and lateral incisors. The condition was mistaken by the dentist for an alveolar abscess, who drilled into the left central only to find a live pulp, which was removed and root filled. In the operation the perfect natural crown was so mutilated that a Logan crown was subsequently adjusted. The pus still continuing to flow, an attempt was made to open into the lateral, as the skiagraph shows. On finding another live pulp, the dentist became discouraged, to say nothing about the patient, and referred the case. The curettement of two rather stubborn pyorrheal pockets effected a cure.

that the removal of the pulp of a badly affected pyorrheal tooth is followed by a more rapid response to the local treatment of the disease. The theory has been advanced that in the removal of the pulp the entire circulation of the tooth is thrown to the sluggish pericemental membrane and thus stimulation is brought about. This is an erroneous idea, for Noyes and Broomell have clearly demonstrated histologically that the pericemental membrane normally is well supplied with blood-vessels, and that to extirpate the pulp would not materially affect the circulation to this membrane. However, there are many cases

wherein the removal of the pulp is clearly indicated—not, however, because of the supposed stimulation which results, but because of its low state of vitality and ultimate death, in which case the pyorrheal condition is liable to be complicated by the presence of an alveolar abscess. Fig. 42 illustrates the result of a mistaken diagnosis, where a pyorrheal condition was mistaken for an alveolar abscess.

Denuded Roots.—Whenever a single root of a multi-rooted tooth is practically denuded of its pericemental attachment, with the remaining roots in fairly good condition, the badly affected root should be completely excised. Such a condition is illustrated in Figs. 43 and 44.

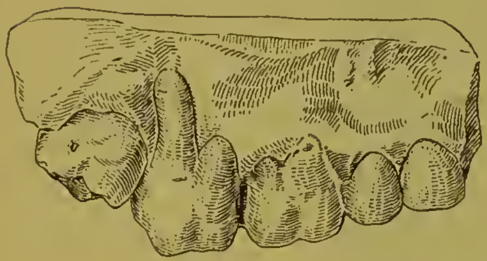

FIG. 43.

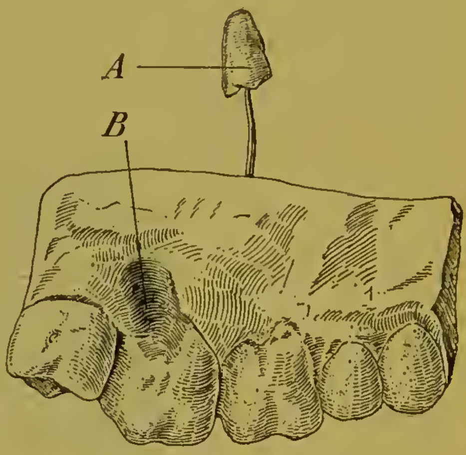

FIG. 44.

FIG. 43.—This shows an exposed molar root, such as is frequently encountered in the treatment of pyorrhea alveolaris.

Fig. 44.—This shows the case after the excision of the root. *A*, excised root; *B*, cavity after removal.

This necessitates of course the removal of the pulp and the filling of the root. If two roots are thus affected, the tooth had better be extracted.

The use of local anesthetics is not advised. To further poison the tissues by actual injection when they are already in a low state of vitality is contraindicated, and the slight anesthesia otherwise induced is too often obtained only at the expense of quite as much pain as the careful scaling and curetting with the proper instruments would produce. The parts not being anesthetized serves as a guide to the careful operator in locating the pockets when the surgical treatment can be accomplished with a minimum amount of injury to the soft parts involved. If care and judgment is exercised, neither the pain nor the discomfort is as great as might naturally be supposed.

After the surgical treatment is completed, the prophylactic treatment with the usual instructions should be given. Patterson[1] states that "experience has taught that the time spent in smoothing the roots is well

[1] Johnson's Operative Dentistry, p. 467.

worth the endeavor, for the rapidity and permanency of the recovery is greatly enhanced, and the operation cannot be considered completed until as much time is given to the polishing as to the removal of the deposits."

2. **Medicinal Treatment.**—The medicinal treatment for this class of cases is practically the same as for the preceding class. The pockets should be washed out thoroughly after the surgical treatment. This may be accomplished with either the spraying apparatus or water syringe, having a small point on the nozzle. Iodin, because of its penetrating and stimulating property, is especially efficacious in these bone affections. The case generally yields nicely when the application of the local astringent remedy is made at intervals of two or three days. The time of making the subsequent applications should gradually be lengthened, and in about two or three weeks the case should be ready for the patient to care for themselves. It should be remembered that in this class of cases the patient, as well as the dentist, is confronted with a more serious proposition. The instruction, therefore, should be explicit and the progress of the case closely watched.

In stubborn pus pockets it is sometimes necessary to thoroughly cauterize the area involved in order to check the pus formation. For this purpose excellent results may often be had from the use of a 25 or 50 per cent. solution of phenolsulphonic acid. This is a valuable stimulating agent, and may be applied deep down into the pocket with a Dunn drop applicator; on general principles, however, the use of acids in the treatment of this disease is contraindicated, not because they will not assist Nature in effecting a cure, but because of the extreme sensitiveness which they produce. Phenolsulphonic acid is an exception to the rule, as this agent does not leave the teeth sensitive.

Occasionally the pus formation will persist in a pocket where we are reasonably certain that the ordinary surgical treatment has been thorough, and where also the pocket has been cauterized. Here we can suspect resorption of the root in the apical area, leaving sharp, needle-like points, which keeps up the irritation. In these cases it is necessary to amputate the root-end or extract the tooth. The author's experience with replantation as a last resort in the cure of badly affected teeth in pyorrheal or abscessed conditions has not been encouraging. For permanent results it is absolutely essential that the replanted tooth be held firmly in position by some permanent appliance, and generally its extraction and the insertion of an artificial tooth is far more sanitary and satisfactory. It is not a question here of what a dentist can do by his ingenuity and skill, but rather a question of what is best for the patient.

Head, of Philadelphia, has recently brought forth the use of ammonium hydrogen fluorid as a tartar solvent in the treatment of pyorrhea alveolaris. The solution which he recommends is made as follows: Commercial hydrofluoric acid is completely neutralized with ammonium carbonate and ammonium fluorid formed which dissolves in the water present. This solution is filtered, and as such has little chemic action on the so-called "tartar" on the teeth. To make the more active acid salt solution the ammonium fluorid solution is now evaporated in a leaden dish to one-half of its original bulk, an equal amount of hydrofluoric acid is added, and the whole again evaporated to one-half of its bulk. The resulting solution is ammonium hydrogen fluorid.

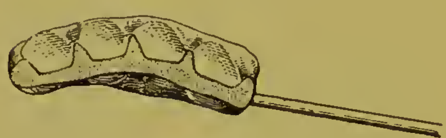

FIG. 45.

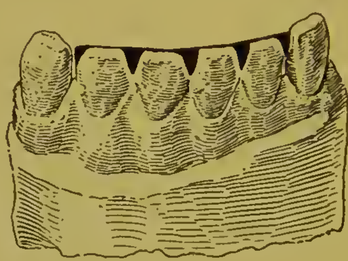

FIG. 46.

FIG. 45.—This shows the retainer in wax with the sprue inserted ready to be invested for casting.
FIG. 46.—This shows the completed appliance set on the model.

DIRECTIONS FOR MAKING.

A modeling compound impression is taken of the cutting edge and upper lingual third of the teeth to be included in the appliance. From this impression a model is made with a good investment material. It is best to let it set over night, when the modeling compound can be removed by using dry heat. Care should be exercised so as not to chip the margins of the investment teeth. On this model the retainer can be made in wax just as it is desired when completed. The model is trimmed so it will enter a casting flask, the sprue inserted and it is ready for investing (Fig. 45). After casting, it is finished and set in the usual manner. (Fig. 46.)

Great care must be exercised in making this solution, for if any of the hydrofluoric acid is left free, its action would produce serious results.

Head recommends making the application to a pyorrheal pocket with a rubber syringe having a platinum point or with a drop applicator. The claim is made that it will dissolve the deposit without any deleterious effect on the soft tissues. At this time varying reports are given, for and against the use of the remedy. The author again desires to emphasize the precautions to be observed in obtaining a solution of ammonium hydrogen fluorid free from uncombined hydrofluoric acid, for a burn from this acid is at best a stubborn condition to treat, especially in the mouth where there is always danger of a mixed infection.

The raising of the opsonic index has been suggested as a means of combating the disease, as has also the use of a specific vaccine (Hecker). The efficacy of these methods have not been sufficiently demonstrated to merit a discussion in a work on "practical therapeutics" at this time. It is to be hoped the true cause of pyorrhea alveolaris will soon be discovered, when the medicinal treatment can be instituted along more rational lines or, what would be better, to inaugurate such prophylactic measures that the disease might be prevented.

In our present state of knowledge it must be stated that too much dependence should not be placed upon drugs, for at this time there is no known specific for the cure of the disease.

Where the loss of tissues has been extensive and the teeth are so loose as to interfere with their usefulness in mastication, the correct treatment necessarily includes the making of mechanical appliances for their support.

3. **Mechanical Treatment.**—The importance of what the

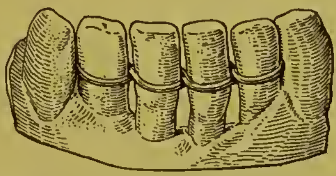

FIG. 47.—This shows loosened lower anterior teeth, temporarily wired with a 26 gauge platinoiridium wire, to hold the teeth during the scaling process, after which a permanent retainer, as illustrated in Figs. 45 and 46, was adjusted.

author has chosen to call the mechanical treatment of the disease under consideration has previously been emphasized. The detailed descriptions of the method of making the various mechanical appliances is not properly included in a work of this character. The proper appliance for holding loose teeth in the jaw will naturally suggest itself to the ingenious dentist. They consist of a combination of inlays, crowns and bridges, the so-called splints, and various retainers. For the benefit of the beginner a splint suggested by Dr. C. L. Hine, of Tuscola, Ill., for loose teeth, which need not be devitalized, is illustrated and briefly described in Figs. 45, 46 and 47. On the following pages the reader will find Figs. 48 to 60, inclusive, with descriptions which were furnished the author by Dr. Lee K. Stewart, of Chicago, and explain fully his method of treating the conditions under consideration from the mechanical view point.

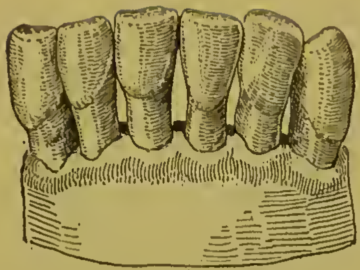

Fig. 48 A.

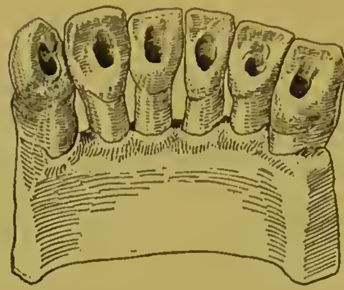

Fig. 48 B.

Fig. 49 A.

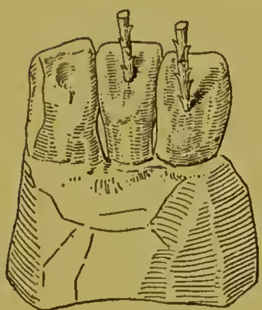

Fig. 49 B.

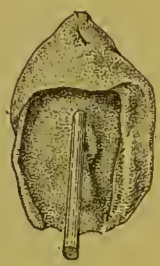

Fig. 50 A

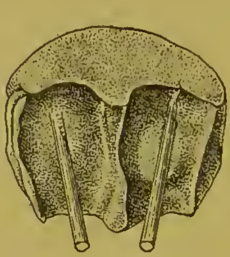

Fig. 50 B.

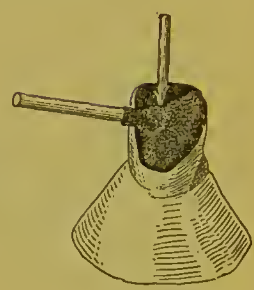

Fig. 51 A.

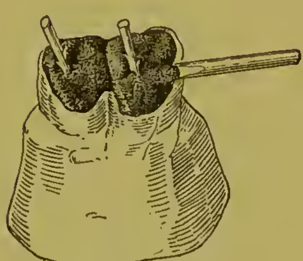

Fig. 51 B

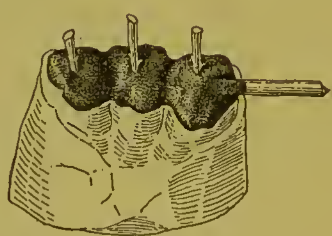

Fig. 51 C.

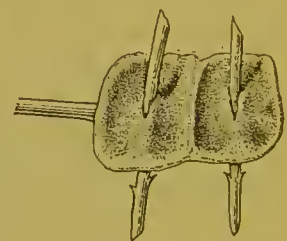

Fig. 52.

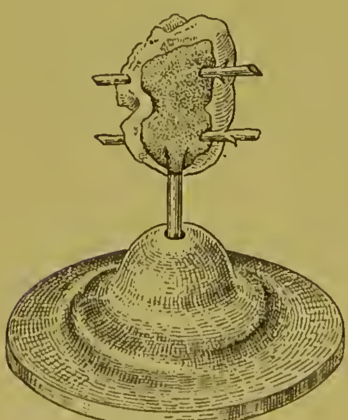

Fig. 53.

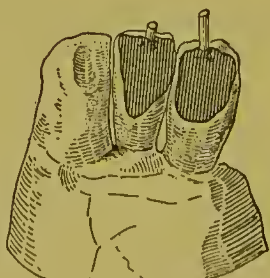

Fig. 54.

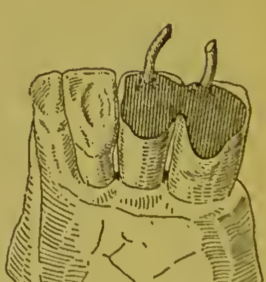

Fig. 55.

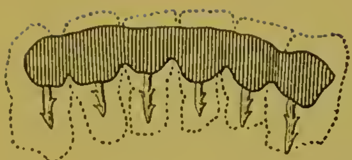

FIG 56

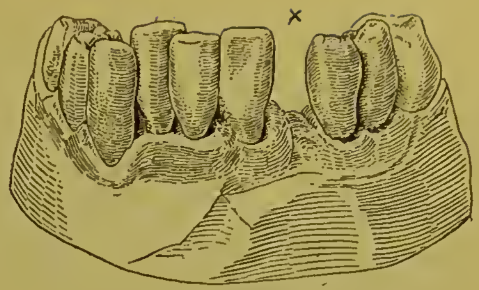

FIG. 57.

FIG 58.

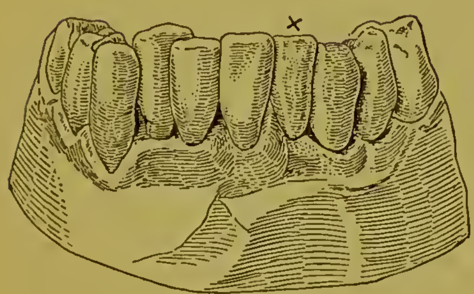

FIG. 59.

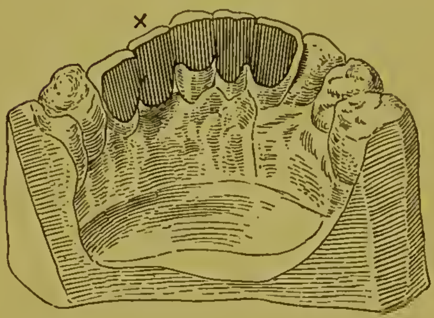

FIG. 60.

FIG. 48.—"A" and "B". Loose Teeth from which the pulps have been removed, the canals filled, prepared for insertion of soft platinum wire and ready for the wax pattern or modeling compound impression.

FIG. 49.—"A" and "B". One or more teeth with soft platinum wire in position. The exposed end is barbed to hold either in the wax pattern or the impression material. The operator may prepare the wax model for casting directly upon the tooth, or upon the models.

FIG. 50.—"A" and "B". Modeling compound impressions of one or more teeth.

FIG. 51.—"A", "B" and "C". Models of one or more teeth made from impressions, waxed and ready for investing for casting. Notice the pin has been placed to direct the flow of gold *by* rather than *at* the model. Models made of equal parts of plaster and silica.

FIG. 52 —Double wax model made directly upon the teeth and ready for investment.

FIG. 53.—Method of investing.

FIG. 54.—Two castings in position and ready for the impression. Notice the exposed end of soft platinum wire has not been cut off. Do not attempt to assemble more than two at one time, and take the impression of the parts ready to be united either with a small piece of modeling compound or just a little plaster. Fill the impression with ordinary soldering investment, separate and solder.

FIG. 55.—Two castings soldered. Continue in this manner, making single, double or larger castings, either from models or by carving the wax upon the natural tooth.

FIG. 56.—Finished case with pins well barbed. Do not cut barbs opposite each other and remember the exposed ends of soft platinum wire are not cut off until case is ready for the final polishing. No gold should be noticeable in the patient's mouth. The larger barbs will prevent a tooth that has been shortened from dropping below the others.

FIG. 57.—A case with loss of the lateral incisor.

FIG. 58.—Retaining appliances replacing lost incisor. Many cases present where one or more teeth have been lost and the others very loose. This appliance will support the loose ones and replace the lost ones.

FIG. 59.—Labial view.

FIG. 60.—Lingual view.

This method can be used in any place in the mouth to support loose teeth and to carry bridged ones.

Where it is desirable to retain the pulps, use one or two short soft platinum pins in each tooth and prepare nearly parallel pits as far away from the pulp as possible. Before placing the appliance, barb the pins well and undercut the cavities. (*L. K. Stewart.*)

CLASS III.

In considering the therapeutics of this class of cases from the dental viewpoint it can be stated that the treatment is both *local* and *general.*

1. **Local Treatment.**—The local treatment involves practically the same surgery, drugs and remedies, and mechanical appliances as in the preceding classes, modified only to meet the conditions as found. To be effective and permanent the treatment by the dentist must be done conjointly with the general treatment by the physician in charge.

2. **General Treatment.**—Whenever the local condition in the mouth seems to be aggravated, if not caused by some of the systemic diseases elsewhere mentioned, it is the plain duty of the dentist to refer the patient to their family physician for the general treatment. In fact, it is almost useless to undertake the local treatment unless measures are simultaneously instituted for the correction of the systemic disease; but when the physician and dentist work together in harmony, it is surprising what great relief can be given the patient by the proper local treatment, for the mouth in many instances is in a hideous condition.

In conclusion, I desire to state that it is a pleasure to work for pyorrheal patients. In many instances they have been informed that nothing could be done, and that they must soon lose their teeth; therefore, in most cases, they appreciate fully your every effort.

NEURALGIA.

GENERAL CONSIDERATIONS.

Neuralgia may be defined as a severe paroxysmal pain in the area of distribution of a nerve, or along its course; and, according to Barrett, true neuralgic pain is principally confined to the afferent or sensory nerves but it may be of a reflex character and hence have its origin in the efferent or motor nerves. It is not a disease in itself, but is rather a manifestation of a disease or perverted function; therefore the conditions which may cause neuralgia are many and varied; and, for convenience in study, they may be classified as follows:

I. General Diseases.

1. *Those Which Lower Vital Resistance.*—This class includes anemia, or other diseases which interfere with such vital functions of the body as the circulation, respiration, secretion, digestion, assimilation and elimination.

2. *Those Which Produce Foreign or Abnormal Substances in the Blood.*—This includes syphilis, gout, rheumatism, diabetes, nephritis, malaria, chronic pyemas, metallic poisoning, etc.

II. Local Diseases.

1. *Those Which Cause Reflex Peripheral Irritation.*—In this class is included *diseases of the teeth*, eyes, ears, stomach, uterus, and ovaries.

2. *Those Which Produce Pressure.*—This includes various tumors, and especially such abnormal growths as occur within bony canals through which nerve-trunks pass.

3. *Chronic Inflammation of the Nerve-sheath or of the Nerve Itself.*—This includes neuritis, or actual diseased conditions of the nerve.

III. Certain Intractable Cases.

This class includes a large number of cases of neuralgia for which no cause can be found.

The neuralgias which generally come under the observation of the dental practitioner are chiefly tho e manifested in the area of distribution or along the course of the fifth cranial nerve, and are accordingly called *facial*, *trifacial* and *trigeminal neuralgia.*

24

FACIAL NEURALGIA.

There are many local conditions in and about the teeth which cause facial neuralgia.. Chief among which are:

1. Pulpitis.
2. Pulp nodules, partially calcified pulps, and secondary dentin.
3. Pericementitis.
4. Cementosis.
5. Deposits on the roots of teeth.
6. Infections about the roots of teeth.
7. Exposed dentin and cementum.
8. Impacted teeth.
9. Faulty occlusion.

THERAPEUTICS.

The first essential in the treatment of neuralgia due to diseases of the teeth is to ascertain the cause and remove or correct it, if possible. As Harlan says, "the dentist should consider no time lost in an endeavor to find the cause of facial neuralgia." It is essential here, as in all treatment cases, to make a correct diagnosis. In most cases the symptoms are of the subjective variety and a correct diagnosis is often difficult to make. It is necessary oftentimes to take into consideration the diseases outlined in the classification on the preceding page; and it is also well to remember that women are especially prone to neuralgia during the period of the so-called "change of life." Fortunately, however, by means of skiography many of the conditions mentioned as being productive of facial neuralgia may be positively diagnosed. Illustrations of several of these conditions are found on the following page in Figs. 61, 62, 63, 64, 65, 66, 67 and 68. Dr. J. N. Crouse, of Chicago, reports an interesting case in his practice which occurred before skiography was known (see Figs. 69, 70, 71 and 72). The author desires to emphasize the importance of ascertaining, if at all possible, the cause of the neuralgia, for upon this depends largely the method of applying our therapeutics. With the cause known, the treatment is of two kinds—*medicinal* and *surgical*.

I. Medicinal Treatment.—The medicinal treatment of facial neuralgia may be subdivided into *local* and *general*.

1. **Local Treatment.**—There are many drugs and remedies which act favorably upon the sensory nerve-endings, and are therefore efficacious in the local medicinal treatment of this disorder.

The author's dental liniment mentioned in connection with non-

FIG. 61.—This skiagraph, taken by Ream, shows an impacted lower third molar, frequently the cause of facial neuralgia.

FIG. 62.

FIG. 63.

FIG. 64.

FIG. 65.

FIGS. 62, 63. 64 and 65.—These all show cementosed roots, the cause of facial neuralgia.

FIG. 66.

FIG. 67.

FIG. 68.

FIG. 66.—This shows a lower third molar coalesced to and between the roots of the lower second molar.

FIG. 67.—This shows a pulp nodule nearly one-quarter of an inch long which fits the canal as perfectly as a pea fits the pod. The tooth for years had carried an ill-adjusted shell crown, which had been placed without devitalization and the proper trimming of the root.

FIG. 68.—This shows various size pulp nodules.

septic pericementitis (p. 298) will often give excellent results, or any of the following remedies may be prescribed:

℞—Mentholis,		gr. xxx (2.0 gm.)
Alcoholis,		
Etheris,	āā	fʒvi (24.0 c.c.)
Chloroformi,	q. s. ad.	f℥iij (90.0 c.c.)—M.

Sig.—Apply by vigorous rubbing or massage over the area of distribution of the affected nerve, or along its course.

℞—Camphoræ (gum),		ʒij (8.0 gm.)
Tincturæ aconiti,		f℥j (30.0 c.c.)
Linimenti saponis,	q. s. ad.	f℥iij (90.0 c.c.)—M.

Sig.—Use as above.

W. H. Truman suggests the following:

℞—Camphoræ (gum),		ʒj (4.0 gm.)
Etheris,		fʒij (8.0 c.c.)
Alcoholis,		f℥j (30.0 c.c.)
Chloroformi,	q. s. ad.	f℥iij (90.0 c.c.)—M.

Sig.—Use as above.

The various liniments here given have practically the same therapeutic effect—that of a sedative upon the peripheral sensory nerves.

In cases where the pain comes from pericementitis or from a developing abscess associated with the upper anterior teeth, it may be stopped in many instances like magic by spraying the posterior nares with alcohol and water, as suggested by Keefe (see p. 310).

Electricity is often of great value. Marshall suggests applying the positive pole of a galvanic battery to the painful spot, when a current of from one to three milliamperes is applied from two to five minutes.

2. **General Treatment.**—The general medicinal treatment involves the administration of drugs systemically. If certain drugs are indicated for the correction of some systemic derangement which is causing reflexly the facial neuralgia, as, for instance, iron compounds in anemia, quinin in malaria, mercury and iodids in syphilis, etc., they had better be prescribed by the family physician. Here again is a condition wherein the best results in the treatment of which are only obtained by both the family dentist and physician working in harmony. Cases have been authentically reported where physicians had treated patients systemically for neuralgia for months without effect, when ultimately the case was cured instantly by the dentist in relieving some local condition about the teeth. While, on the other hand, dentists have been known to keep patients suffering for months in an

endeavor to locate the cause about the mouth, when ultimately the correction of some systemic trouble cured the local neuralgia.

While patients should be referred to the family physician for the general treatment of constitutional diseases, it is not only the privilege but the plain duty of dentists to prescribe internal drugs for the relief of pain while the cause of the neuralgia is being searched for and removed. It is true that this involves a knowledge of drugs and their uses, but surely this is not too much to expect of the trained dental practitioner of to-day. The classes of drugs indicated for the control


FIG. 69.


FIG. 70.


FIG. 71.


FIG. 72.

The above figures are illustrations of perfectly sound teeth which were extracted from one mouth. The symptoms were different from those of any other case with which I have had to deal. When the patient first presented, in the middle of the night, he was suffering such severe paroxysms of pain that during one of the attacks he dropped to the floor almost senseless. The attacks were of short duration, but several occurred before I could learn what the trouble was. Directly after one of these spells, by tapping the teeth on the side where the pain was most severe, I found slight sensitiveness, particularly was this so of the first upper bicuspid, although the pain radiated all over the head. I attempted to drill into this tooth and found the canal obliterated, so I extracted it (Fig. 69). Notice also the cementosed root. The history of the other teeth (Figs. 70, 71 and 72) is similar, except I was able to locate the trouble with less difficulty after the first experience, then, too, the disease had not progressed quite so far before the teeth were extracted. I lost track of the patient and do not know whether he had further trouble or not. (*J. N. Crouse*).

of pain are the hypnotics or general anodynes or analgesics. Several prescriptions are here given. The practitioner can select the one which best seems to suit the case at hand.

℞—Pulveris acetanilidi comp., gr. xx (1.3 gm.)
Fiat chartula No. iv.
Sig.—Take one powder every hour until two or three are taken; if not relieved after two or three hours, take the remaining one or two.

In cases of neuralgia of rheumatic origin phenacetin may be combined with salophen and codein sulphate to control the pain. A prescription follows:

℞—Phenacetini,		
Salophen,	āā	gr. xx (1.3 gm.)
Codeinæ sulphatis,		gr. j (0.06 gm.)—M.
Fiat chartula No. iv.		

Sig.—Take one powder every two hours.

When the neuralgia is associated with nervous headache the following prescription may be given:

℞—Caffeinæ citratis,	gr. xij (0.8 gm.)
Phenacetini,	ʒss (2.0 gm.)—M.
Fiat chartula No. vj.	

Sig.—Take one powder every two hours until relieved.

Occasionally patients do not like to take a powder, preferring a liquid preparation. In these cases we can prescribe antipyrin in solution with an aqueous vehicle, for, unlike acetanilid and phenacetin, this drug is soluble in water. Sometimes it is advisable to combine the coal-tar analgesics with a bromid, a prescription for such a combination is here given:

℞—Antipyrini,		ʒss (2.0 gm.)
Sodii bromidi,		ʒj (4.0 gm.)
Glycerini,		f℥ss (15.0 c.c.)
Aquæ cinnamomi,	q. s. ad.	f℥ij (60.0 c.c.)—M.

Sig.—Take a dessertspoonful three times a day, and oftener if conditions necessitate.

Sometimes the coal-tar analgesics fail to produce the desired effect, in which case there is always one drug that can be relied upon to control the pain, and that is morphin. This drug is truly indicated for the control of pain from whatever source and may be given here in 1/8 gr. (0.008 gm.) dose, but under no conditions should a prescription be written for the drug. Many patients are in the habit of keeping a copy of the prescription, and when the remedy works well in a certain case they often get the prescription refilled for themselves or friends on the least provocation. In the case of morphin this might innocently lead to the "habit." Tablets containing the usual dose (1/8 gr. —0.008 gm.) may be kept on hand, and, if necessary, two such tablets may be given by the stomach within one-half hour, and then the patient can take one tablet home—never more than one, if two have been given at the office, which can be taken in the course of one hour, if not relieved.

When the patient is unable to sleep, chloral hydrate or butyl-chloral hydrate may be prescribed. The fifth nerve is supposed to be

especially sensitive to the influence of butyl-chloral hydrate. A prescription follows:

℞—Butyl-chloralis hydratis, ʒj (4.0 gm.)
Fiat capsula No. xij.
Sig.—Take one capsule every three hours until four are taken.

In cases where a tonic is indicated, as in anemia, the official syrup or glycerite of iron, quinin, and strychnin phosphate may be given. A prescription for the syrup follows:

℞—Syrupus Ferri, Quininæ et Strychninæ phosphatis, f℥iij (90.0 c.c.)
Sig.—Take a teaspoonful in water before meals.

Where the neuralgia is of malarial origin, quinin is indicated. An excellent prescription follows:

[1]℞—Quininæ Valerianatis, gr. xviij (1.2 gm.)
Extracti Hyoscyami, gr. iv (0.25 gm.)
Extracti Cinchonæ, gr. viij (0.5 gm.)—M.
Fiat capsula No. xij.
Sig.—Take one capsule before meals and on retiring.

It will be noticed that only a few doses have been prescribed in any of the above prescriptions. This precaution has been taken because some of these patients suffer untold agony; in fact, they may be considered temporarily demented, and no matter how specific your verbal and written directions have been, they may ignore your directions entirely and take one dose after another on the general principle that "if a little is good, more is better," until they have taken such a quantity as may result in an overdose. Therefore, it is well for dentists especially to be careful in this respect.

II. Surgical Treatment.—The surgical treatment often involves major surgery, for a discussion of which see works on Oral Surgery.

TIC DOULOUREUX.

The discussion of facial neuraliga would indeed be incomplete without at least brief mention of *tic douloureux*, so named by Trousseau, a Frenchman. The condition frequently results from chronic irritation of the fifth cranial nerve. The pain is very acute, and occurs in distinct paroxysms, gradually increasing in severity, until it reaches a climax, when it quickly subsides. The attack may occur at any time and is provoked by speech, laughing, talking, the movement of a muscle, etc., and even slight noise or a light touch, as placing the hat on

[1] Taken from the *Dental Cosmos*.

the head, may cause a paroxysm. The patient lives in constant dread of an attack.

There is no condition which elicits greater sympathy than this, for the experienced physician or surgeon realizes that little can be done either medicinally or surgically. Materia medica has been exhausted in search of a cure, and surgery affords only temporary relief. Patrick, Moyer, and others report favorably upon the use here of castor oil. The drug is first pushed to almost catharsis, then checking the dose, but still keeping up the administration of the drug. Ultimately the patient can take large quantities of castor oil without the cathartic effect.

Stekoulis, Schapiro, Bennett, Murphy, and others have injected osmic acid into the substance of the affected nerve and report encouraging results.

Deep injections of alcohol in the region of the orbit of the affected nerve for the relief of facial neuralgia has been recently suggested. Patrick, Moorehead, Potts, and others report favorably on the method. The needle generally employed is one adopted by Levy and Bandonin, which is graduated in centimeters up to five. The alcohol should be about 75 per cent., and should contain a very small amount of cocain hydrochlorid. The success of the operation will be indicated by a slight anesthesia over the parts supplied by the nerve. Upon the slightest return of the pain the operation should be repeated, after which relief for some months, and even two years or more, may be expected. The formula used by Patrick is here given:

℞—Cocainæ hydrochloridi,		gr. j (0 064 gr.)
Chloroformi,		m. x (0.61 c.c.)
Alcoholis,		f℥iij (12 0 c c.)
Aquæ, distillatæ,	q. s ad.	f℥ss (15.0 c.c)—M.

Sig.—Use as directed above.

On the whole, it may be stated that the therapeutics of tic douloureux is discouraging to all concerned. Hirt sums up the conditions very properly when he says: "Numerous are the means at our command for combating tic douloureux, and quite as numerous are the patients who, after hundreds of unsuccessful trials, have given up in despair all medicines and all physicians."

The condition has not been thus briefly discussed here because of the likelihood of dentists being called upon to treat it, but rather because they are often called in consultation on the case to aid in making a correct diagnosis.

DISEASES OF THE SOFT TISSUES OF THE MOUTH NOT DIRECTLY ASSOCIATED WITH THE TEETH.

GENERAL CONSIDERATIONS.

In this general group will be considered the diseases of the soft tissues of the mouth other than those directly associated with the teeth. The etiology and pathology of these diseases will be considered somewhat more fully than has been done with the diseases of the hard tissues of the mouth and associated structures, for the reason that dentists, as a rule, are not so familiar with the etiology and pathology of the diseases under consideration here, and therefore find it more difficult to differentiate between some of these conditions and to make a correct diagnosis—upon which the successful therapeutics is based.

The mouth is a hot-bed for many kinds of bacteria, and is therefore a fruitful field for diseases of almost every description.

CANKER SORES.

Canker sores are true ulcers and are among the more common pathologic conditions of the soft tissues of the mouth. They are supposed to have their origin primarily in the mouth, yet Pusey and others believe them to arise from trophic disturbances. The author has observed that women are peculiarly susceptible to this condition during the menstrual period. Some women have canker sores nearly every time they menstruate. They seem to be associated also with gastro-intestinal disturbances. They always appear suddenly and are very persistent unless given suitable treatment.

Gilmer[1] states "that they most commonly occur at the duplicature of the mucosa of the cheek and the gums, though they are occasionally seen on the floor of the mouth and on the edges and under the surfaces of the tongue. They vary in size from that of a grain of wheat to that of a small-sized bean. Their depth varies, but they can never be considered superficial. Their margins are rather well-defined, but not so markedly as are chancrous ulcers of similar tissues, neither are they so irregular as are lupus ulcers of the mouth. The mucosa

[1] *Dental Review*, Vol XXIII, p. 496.

for a quarter to a half-inch from the ulcer is of a deep red color. The base of the ulcer is overlaid with a grayish-white necrotic covering, not unlike that found in syphilitic ulcers in the mouth. When this coating is removed, a granulating surface is exposed, which, while extremely sensitive to the touch, bleeds but slightly, if at all. These ulcers are so distinctive in their appearance that they can hardly be mistaken for any other lesion."

Therapeutics.—The treatment of canker sores is purely local, and the sooner it is instituted the less persistent the ulcer will be. The necrotic tissue may be carefully removed by scraping, or cleansed with hydrogen dioxid, after which the raw surface should be dried and cauterized. They generally yield nicely to one application of silver nitrate. For this purpose a 10 per cent. solution may be used; a 20 per cent. solution of argyrol may also be employed. The ulcer being acutely sensitive, it is sometimes better to use 95 per cent. phenol as the cauterizing agent. The analgesic effect thus produced is often of value. The mouth should be kept clean, when the ulcers usually heal without further treatment.

HERPES LABIALIS.

Herpes labialis, also called cold sores or fever sores, have a similar origin to canker sores. They are of a herpetic nature, and differ in appearance from the latter principally on account of location and tissues involved. They occur frequently when the patient is suffering from colds or during convalescence from fevers, hence the name. Of these Gilmer says: "herpes of the lips (herpes labialis) and occasionally of the gums, (herpes gingivalis) sometimes follow dental operations and cause uneasiness on the part of patient, who often attributes this condition to infection from unclean armamentarium used by the dentist, when, in truth, the patient is of a herpetic diathesis, and under such circumstances a slight irritation only, in such locations, being sufficient to excite the condition."

Therapeutics.—The treatment of cold sores consists in cleaning the part with such agents as hydrogen dioxid or alcohol, then drying and making an application of oil of cloves or spirit of camphor. Either of these latters agents are just sufficiently irritating to produce stimulation of the cells and promote healing. If the cold-sore is large and liable to crack and bleed by moving the lips, it can be kept soft and pliable by frequently applying euroform paste, or immobilization may be had by applying collodion. In the latter instance the part should be dusted with boric acid before coating with collodion.

SYPHILIS.

It is important that every dentist be familiar with the characteristic symptoms of this disease; for acquired extragenital syphilis is primarily manifested in and about the soft tissues of the mouth in what is known as the initial leison or *hard chancre,* which, as a rule, develops in from three to six weeks after infection. The chancre may occur in various locations—on the lips, tips of the tongue, and the pharynx—and is characteristic of what is known as *primary symptoms.*

PRIMARY SYPHILIS.

The infection here is produced by direct contact of the syphilitic virus with an abraded surface. According to Logan,[1] the principal means of conveying the infection extragenitally is through the act of kissing, drinking from a broken utensil, the use of a pipe or handkerchief that has been contaminated with the virus, or from physicians' or dentists' instruments or fingers that have had the infected secretions from the mouth of a previous patient dried upon them.

In the locations found in the mouth, chancre is usually single, though it may be multiple. It may appear first as a papule, the superficial cells of which finally ulcerate, with necrosis of the central area quickly following, when a copious and *highly infectious* discharge comes from the crater-like opening that is forming on the tissues involved. The ulceration occurs in from four to ten days after full development of the chancre, until which time the patient, as a rule, experiences very little pain or discomfort.

Syphilis is a more common disease than is generally supposed, and inasmuch as the characteristic symptoms of the most infectious stage of the disease occur primarily in the mouth, dentists should be ever watchful and guard against the infection of themselves and other patients. Whenever the skin on the hand or finger of the dentist is broken, or the mucous membrane of the patient's lip, gum, or cheek is punctured by an instrument, cauterization of the part should at once be done.

Therapeutics.—The treatment of the primary symptoms is unimportant. In fact, unless a positive diagnosis can be made, and it

[1] *Dental Review,* Vol. XXII, p. 800.

is often difficult to be certain of the clinical diagnosis at this stage of the disease, the treatment had better be deferred until the diagnosis is established by the manifestations of the secondary symptoms. Syphilis is now known to be a germ disease, and the only positive means of confirming the diagnosis of the clinical symptoms in this stage is the microscope by which the *Tryponemata pallidum* (*spirocheta pallida*) may be discovered. These appear as fine, closely coiled spirals, 6 to 15 microns long, feebly motile. They are most abundant in the margins of the lesions, and are practically constant in chancre and mucous patches. Old chancres and those treated by local antiseptics may easily fail to show the organisms (White and Martin). Long[1] says that "positive knowledge upon this point is so important, in view of the question of marriage, of prolonged treatment, and of personal care in spreading of infection, that the matter of a few weeks treatment may be properly disregarded, particularly as it is believed that nothing is lost, in the efficacy of treatment, by the delay." Oral hygiene, of course, should not be neglected. A new remedy has recently been discovered which promises to be a *specific* for syphilis. It is commercially called "606." The remedy, as yet, has not been employed sufficiently long to determine the ultimate results of its use.

SECONDARY SYPHILIS.

The manifestations of what is known as the *secondary symptoms* do not begin to appear until from four to six weeks after the development of the hard chancre. If no treatment has been instituted, eruptions on the skin usually mark the beginning of this stage, and according to L. Blake Baldwin, eruptions are frequently found on the oral mucous membrane quite similar to those upon the skin. These eruptions are accompanied by fever, sometimes preceded by it. Simultaneous with the eruptions and fever characteristic *mucous patches* occur, and may be located on any part of the mucosa of the mouth, regardless of whether the disease originates primarily or secondarily in the mouth. The presence of mucous patches is a positive sign of syphilis. They differ from canker sores in that they have more clearly defined margins and are not so painful to the touch, and the immediate area is not of such a deep red color (Gilmer). The mucous patches are *exceedingly infectious*, and due caution should be observed not to carry the infection from one patient to another.

Therapeutics.—Inasmuch as secondary syphilis is manifested in

1 "Dental Materia Medica and Therapeutics," p. 206.

the mouth and leaves its indelible effects upon the gums, jaws, and adjacent structures, mercury is the one drug indicated in its treatment, for this drug has a selective influence upon these structures. In fact, mercury is a *specific* for the secondary symptoms, though its action, as yet, rests purely upon an empirical basis. It is not even known whether the action of the drug here is due to specific toxicity for the syphilitic virus or whether it is simply due to its general effects upon metabolism. The former, according to Sollmann, seems to be the case. Mercury is not only palliative, but curative in this stage—congenital as well as acquired—whilst its administration is worse than useless in the first and third stages.

The systemic treatment, of course, should be relegated to the family physician. Long[1] very properly emphasizes a word of caution here. He says: "It may fall to the dentist to discover a case of syphilis, by mouth symptoms, where it had not been suspected, but he must be exceedingly cautious about discussing this finding with the patient. He is dealing with a matter for which he has not been consulted, and in any suspicious acts or words of his lie the possibilities of much unpleasantness. If the patient be an innocent wife, a statement of his discovery might produce domestic discord. While she would have a most serious grievance, entitling her to our pity, a revelation could only add to her unhappiness. A suggestion to her to see her family physician for certain general conditions that you find evidence of, would be the proper course; and even this advice must be given tactfully, without arousing suspicion as to the probabilities in the case, for, after all, a mistaken diagnosis is possible."

The preparations of mercury most frequently prescribed in syphilis are mercury with chalk, and compounds like bichlorid, biniodid, and protiodid. The ointments are used by inunction. None of these preparations should be pushed to the extent of producing ptyalism or salivation.

An accurate and positive diagnosis of syphilis should always be made before instituting the mercurial treatment, otherwise disastrous results are almost certain to follow. In a recent case of a little girl seven years old, of doubtful syphilitic history, coming under the observation of the author, a sequestrum was removed which contained the erupted first permanent molar and the crowns of the nonerupted first and second bicuspids. The case terminated fatally.

Syphilographers have learned from sad experience that mercury can be pushed much farther without producing ptyalism, if the mouth

[1] "Dental Materia Medica and Therapeutics," p. 206.

has first received a thorough prophylactic treatment. This includes the removal of all local irritants, such as hard and soft deposits, overhanging fillings, ill-fitting crowns, and bridges. In fact it is only when the mouth and teeth are clean that the symptoms of ptyalism are valuable as an index that the system is taking all the mercury it can absorb without producing marked toxic effects. If the teeth are not clean and the mucous membrane healthy, it is best to wait until the mouth receives proper attention before attempting to find the minimum toxic dose of the drug. On this point, White and Martin[1] state that "the teeth should be put in perfect order by a competent dentist, and should be kept scrupulously clean throughout the entire course of treatment by cleansing washes, astringent and mildly antiseptic powders (or pastes), and careful removal of particles of food by means of toothpicks and dental floss immediately after eating. Upon the health of the mucous membrane of the mouth depends, to a great extent, the ability of the patient to take an efficient quantity of mercury without causing salivation."

Dentists in the past have hesitated to work for patients who were known to have the specific disease on account of the danger of self-infection, and thinking it necessary to subsequently discard all instruments used. Logan[2] says: "These syphilitic individuals can be cared for with impunity if the operator protects his hands with rubber gloves and then scrubs all the instruments employed and boils them for fifteen minutes. If this plan is pursued, there is no need of such absurd action as is often recommended—that all such instruments should never be used again, but thrown away."

TERTIARY SYPHILIS.

This condition may be prevented if proper treatment has been previously inaugurated. In cases not so treated the *tertiary symptoms* usually occur in from one-half to two years after infection. *Gumma* mark the third stage of syphilis and first appear as hard bodies or nodes occurring mostly under the skin, although they may occur under the mucosa of the mouth. They gradually increase in size, become more superficial, with a tendency to break down and ulcerate. When they occur in the region of the hard palate, the underlying bone frequently becomes involved and extensive necrosis of the palate and nasal bones follow. Gilmer[3] states that subperiosteal gumma are especially destructive to bone, and reports having seen cases in which

[1] "Genito-Urinary and Venereal Diseases," Ninth Edition, p. 1008.
[2] *Dental Review*, Vol. XXII, p. 813.
[3] *Dental Review*, Vol. XXIII, p. 498.

the soft palate also was completely destroyed from ulceration of gumma in that locality. Authorities differ in regard to whether the lesions of tertiary syphilis are infectious. They are probably but slightly so, if at all; however, it is well here also to guard against spreading possible infection.

Therapeutics.—The one drug indicated in the treatment of tertiary syphilis is the great alterative, potassium iodid. In this stage of the disease the efficacy of potassium iodid is equal to that of mercury in the secondary stage, and may be considered a *specific*. The systemic treatment should be relegated again to the family physician. The initial dose of the drug should be small, and the amount gradually increased until improvement follows or symptoms of iodism appear. For permanent results it is necessary to continue the antisyphilitic treatment from six months to a year or more.

The question of whether syphilis can be cured or not has been a debatable one in the past, but its cure is no longer questioned by experienced syphilographers. Yet it may be safely stated that few cases are ever permanently cured, for only a small percentage of patients will continue the treatment sufficiently long, after they feel perfectly well, to effect a permanent cure.

It should be remembered that syphilis stamps its indelible effects upon the individual thus afflicted in almost every case, and that any subsequent infection, like in alveolar abscess or pyorrhea alveolaris, is likely to extensively involve the osseous structures, and yield to the ordinary treatment with difficulty. The author has previously referred to a case of extensive necrosis following slight trauma after the removal of a pulp, by pressure anesthesia, where every due precaution was taken to maintain asepsis in performing the operation (see Fig. 12, p. 319.)

In conclusion here I desire to again emphasize the fact that every dentist should so school himself in this dreadful disease that he may be able to at once recognize its various manifestations. When in doubt about a lesion in the mouth, it is always better for dentists to assume that it is specific in character, and take every due precaution against infecting themselves or their patients.

MERCURIAL STOMATITIS.

Mercurial stomatitis is a condition of the mouth frequently following the administrations of mercury and its compounds for the treatment of syphilis and other conditions. The characteristic symptoms, known as ptyalism, and the treatment of the condition have been fully considered under Mercury (see p. 184).

TUBERCULOSIS.

This dreaded disease is known as the "great white plague," and is occasionally seen on the mucosa of the mouth. Gilmer[1] reports having seen three cases, one of the tongue, one of the sublingual salivary gland, and one an extensive involvement, including a part of the lips, the mucosa of the cheek, the soft palate, the tongue, and a portion of the pharynx. The microscope will aid in definitely determining tubercular lesions in the mouth, as well as in other parts of the body. The dentist may first discover the lesion and aid in making the diagnosis; but the treatment had better be done by the general medical practitioner or specialist, for the cases are rare and no definite local treatment has thus far been permanently established. It may be stated, however, that various forms of light have been used in many cases with favorable results in tubercular and similar affections. Where there is bone involvement Beck reports surprising results from the injection of bismuth paste. In this connection it may be remembered that Cook, Moorehead, and others have reported cases where the *tubercle bacilli* have entered the system through the canals of pulpless teeth and pyorrheal pockets, involving the glands in the neighboring region.

LEUCOPLAKIA BUCCALIS.

This is a disease of the mouth and tongue, the etiology of which is as yet unknown. A large percentage of the cases of leucoplakia buccalis give a previous history of syphilis. It is, therefore, suspected that the latter disease has a causative relation to leucoplakia, though no definite evidence in this respect has been produced. Gilmer, who has seen a large number of cases, is of this opinion. He[2] says: "Many cases of leucoplakia buccalis have come under my observation, and, with few exceptions, I was able to elicit a history of syphilis." The disease manifests itself upon the buccal mucosa, portions of the gums and the dorsum and edges of the tongue, and other places. There appears, sharply outlined, whitish or silver-colored points, streaks, bands, or patches of irregular shape, either flattened or slightly elevated above the level of the general mucosa. Ordinarily they simply present a roughened surface without much discomfort. They occur almost exclusively in the mouths of men who are excessive smokers. The condition, however, should not be mistaken for that which is frequently seen in the mouth of excessive smokers, especially pipe smokers, where

[1] *Dental Review*, Vol. XXIII, p. 499.
[2] *Dental Review*, Vol. XXIII, p. 500.

there is a whitening of extensive areas of the tongue or hard palate or both. Gilmer[1] says "that the epithelium of the smoker's tongue is of a brownish-white, while in leucoplakia the patches are of a clear white color." Leucoplakia patches are very characteristic, no other condition of the mouth presents the same clinical picture. The affection is painless, and may be overlooked by the patient unless it becomes complicated with cancer. It has been observed that carcinoma frequently has its beginning in the site of an old leucoplakia patch. Since this is true, an early diagnosis should be made, and the proper treatment instituted by the family physician. In cases of known syphilis the antisyphilitic treatment would be indicated. The general tendency of dentists in conditions of this kind is to use cauterants, such as silver nitrate. In the treatment of leucoplakia this should be avoided as it only tends to aggravate the disease.

ACTINOMYCOSIS.

This disease is common among the lower animals, especially cattle, and is known as *lumpy-jaw.* The disease affects the lower jaw and cervical glands, and cases in the human being have been reported by Brophy, Bevan, Zederbaum, and others. It is produced by the ray-fungus, and the microscope affords a positive means of diagnosis.

The treatment of the disease had better be carried on by the medical specialist, as it is so rare in the human being that dentists but seldom see the condition. The use of copper sulphate in this disease has been previously considered (see p. 76).

ACUTE ULCEROUS GINGIVITIS.

Acute ulcerous gingivitis is a comparatively rare disease. The author, however, has seen a number of cases in the mouths of children coming to the college infirmary for treatment from the so-called "slum districts" of Chicago. This may have been a coincidence, but I have never observed the typical disease in well-kept mouths. It may be regarded as a filth disease. Gilmer[1] well describes it as follows: "The disease attacks simultaneously the gum margins on their buccal or labial aspect about two, three, or possibly four teeth, at the same time. The ulcers come suddenly, quickly destroying the gingivæ down to the alveolar process, but seemingly not invading it, exposing the roots of the teeth to this extent. The margins of the ulcers are everted crater-like, somewhat like chancrous ulcers. The base of the

[1] *Dental Review*, Vol. XXIII, p. 500.
[1] *Dental Review*, Vol. XXIII, p. 501.

ulcers is overlaid with a grayish-white covering. When this covering is removed, the granulating surface bleeds freely. The lymphatics related to the area become enlarged, and, unlike chancrous lymphatic enlargements, are tender. It is also unlike chancre in that the ulcers are nearly always multiple and exceedingly painful to touch. Salivation is much increased, with frequent drooling, the breath is fetid, and owing to the absorption of toxic elements, there is a slight rise in temperature. The contiguous lingual gingivæ become reddened, but do not participate in the ulceration. The condition has been mistaken for syphilis."

Therapeutics.—The ordinary local remedies used for somewhat similar conditions are of little value here unless systemic treatment is simultaneously instituted. Calomel is the drug to give internally. A prescription for which follows:

℞—Hydrargyri chloridi mitis, gr. ij (0.13 gm.)
Sodii bicarbonatis, ʒj (4.0 gm.)—M.
Fiat chartula No. xx.
Sig.—Take one powder every two or three hours.

The local treatment consists in cleansing the ulcer with such agents as hydrogen dioxid, drying the part and applying a 10 per cent. solution of silver nitrate or a 20 per cent. solution of argyrol. If the ulceration is checked, complete restoration of the gum tissue by granulation follows. Mouth hygiene should, of course, be instituted and strenuously carried out.

GONORRHEA.

According to Burchard-Inglis, undoubted cases of oral infection by the specific germ of gonorrhea (*gonococcus*) have occurred. The author has seen at least one such case. The mucosa of the cheeks, gums, tongue, and even of the hard and soft palate may undergo intense suppuration. Mouth hygiene and the systemic treatment of the constitutional trouble cures the case.

There are a variety of tumors and other diseases which manifest themselves in the mouth, involving both the soft and osseous structures, for the diagnosis and treatment of which see works on Oral Pathology and Surgery. The more common of the diseases of the soft tissues of the mouth and their treatment have been thus briefly considered here with the hope of stimulating a greater interest in this phase of mouth diseases.

DENTAL STERILIZATION.

GENERAL CONSIDERATIONS.

Throughout this work the author has endeavored to emphasize the importance of *dental sterilization.* The methods and means of sterilizing tooth-structure and the field of operation have been fully discussed in the description of the various operations which are performed in and about the mouth; but while the importance of having the instruments sterile has been repeatedly mentioned, the means of sterilizing the same has not been previously discussed. The importance of personal cleanliness on the part of the dentist and of his office armamentarium is of course understood and need not be considered here.

A principle in surgery is to avoid the presence of germs. This means that the instruments used must be sterile, as well as the field of operation and the operator's hands. The same principle holds true in dental as well as in general surgery.

There are many practical devices on the market for the sterilization of instruments. By practical here we take into consideration the convenience and the expense. Any apparatus for this purpose must be convenient to use and no reasonable amount of expense should deter dentists from accomplishing this end.

It is to be regretted that many of our most potent disinfectants, such as formaldehyd, mercuric chlorid, etc., while excellent for the sterilization of the hands and the site of operation, cannot be used for the sterilization of metal instruments, on account of the agent acting upon the metal.

A Method for Sterilizing Instruments.—In late years the author relies largely upon moist heat. The method used is here given: The instruments are first brushed with a stiff brush to remove whatever débris may be present, after which they are immersed in boiling water for about two minutes; they are then transferred to a 10 per cent. solution of formalin, to which solution about 5 per cent. of borax has been added. After being in this solution for about two minutes, they are again rinsed in the boiling water, carefully dried, and placed in their proper places in the cabinet. In cases of questionable specific infection, the instruments should be boiled for at least fifteen minutes. Sodium carbonate or borax should be added to the water to prevent rusting of the instruments.

If the instruments are thoroughly dried they can be kept from tarnishing and rusting to a marked degree by having calcium chlorid in the cabinet near the instrument tray. The agent should be in a small glass container without a top. Calcium chlorid is highly deliquescent and readily absorbs the moisture in the air. It should be replenished every few days or whenever it has completely liquefied. This precaution is of special value during the damp days of summer-time when the instruments are more liable to rust.

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